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FRONT COVER

CEDRUS DEODARA NATURAL FOREST, KANASAR, CHAKRATA FOREST DIVISION, U.P.

Photo - Tilak Raj

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FAREWELL

Shri Pankaj Khullar, I.F.S., relinquished charge of the post of the Head, Silviculture Division, Forest Research Institute, Dehra Dun as well as the charge of Honorary Editor of the *Indian Forester* on 30th April 1996, after a successful five and half years tenure, from 13th November, 1990 to 30th April, 1996.

Shri Khullar is an IFS Officer of 1971 batch and belongs to Himachal Pradesh cadre of the Indian Forest Service.

We gratefully acknowledge the valuable contribution of Shri Khullar in welfare and well-being of the *Indian Forester*.

* * *

WELCOME

The *Indian Forester* welcomes Shri P.B. Gangopadhyay, I.F.S., on his appointment to the post of Head, Silvicultre Division, Forest Research Institute, Dehra Dun, as well as Honorary Editor of the *Indian Forester* on 6th May, 1996.

Shri Gangopadhyay is an IFS Officer of 1975 batch and belongs to Madhya Pradesh cadre of the Indian Forest Service. His past association with this eminent international forestry journal will, no doubt, stand him in good stead in providing inspiration and encouragement.

* * *

PRIZES

We have the pleasure of announcing the *Brandis, Schlich, S.K. Seth, Chaturvedi* and *Indian Forester* Prizes for the year 1994 to the following recipients to whom we offer our heartiest congratulations :

	Author(s)	Paper
		Brandis Prize
1.	S/Shri P.A. Malwade, A.K. Srivastava and G.S. Pandey	"Productivity and economics of some commercially important forest trees" - January 1994
2.	S/Shri A.N. Chaturvedi and B.S. Rawat	"Poplar tree improvement programme" - February 1994
3.	Shri P.K. Roy Choudhari	"Preliminary observations on control of stumping through mangrove afforestation at Nayachara" - May 1994
4.	Shri Shyam Lal	"Rehabilitation of open cast coal mines in Singrauli region of U.P. and M.P." - May 1994
5.	Late Shri Gurdev Singh	Cover Photo - April 1994
		Schlich Prize
1.	S/Shri B.P. Singh and P.D. Ambaskar	"Normalcy and normal forest" - November 1994
		S.K. Seth Memorial Prize
1.	Shri S.A. Shah	"Ecology aspects of tropical forest management" - November 1994
2.	Dr. A.K. Bhattacharya	"Efficacy of tree species towards gaseous pollutants and its significance in air pollution control by plantation of pollution resistant trees" - August 1994
		Chaturvedi Prize
1.	S/Shri A.K. Nigam, D.K. Tyagi and S.M. Gujar	"An approach to the management of grasslands in Great Indian Bustard areas" - October 1994
		Indian Forester Prize
1.	Rakesh Shah	"Fuel bricketing machine" - August 1994

EVALUATION OF PROVENANCES OF *PINUS CARIBAEA* VAR. *HONDURENSIS* AND *PINUS TECUNUMANII* FOR THE SITES OF WESTERN GHATS FOR RAISING PULPWOOD PLANTATIONS

K.M. SATISHCHANDRA[1], G.S. KARIYAPPA[2], S. NAGARAJ[3] AND G.K. SHENAVA[4]

Mysore Paper Mills Limited, Shimoga (Karnataka)

Introduction

The forest raw material used in the manufacture of paper contains both short and long fibres. The Mysore Paper Mills Ltd., Bhadravathi (Karnataka) with an installed capacity to manufacture 75000 tpa of newsprint and 37000 tpa of cultural paper. The mill was totally dependant on Bamboos as long fibre raw material but availability of Bamboos to the mill has become critical recently. The mill started planting Bamboos admixed with softwoods in pulpwood plantations raised on degraded forest lands leased to the mill by the Karnataka Forest Department but Bamboos have failed to establish successfully. Therefore the mill started intensive search for alternative sources of long fibre raw material and found the source in Tropical pines.

The degraded forest lands leased to the mill comprises some areas on the Western Ghats with edaphic and climatic conditions congenial for raising Tropical Pine plantations. The mill started raising Tropical Pine plantations on an experimental scale during 1981 and after confirming successful establishment of the plantations there is a plan to establish about 6700 ha of Pine plantations to meet the long fibre raw material requirement of the mills on a sustained basis.

Initial trials comprising different Tropical Pine species indicated that *Pinus caribaea* var. *hondurensis* is the most promising and suitable species for the locality followed by *Pinus tecunumanii*. Therefore experimental trials comprising different provenances of these two species were taken up to identify most desirable provenances for higher and sustainable productivity.

Materials and Methods

(a) *Geographical range, Soils and Climate* : The experimental site lies at 15⁰ 14' 40" N latitude, 74⁰ 14' to 75⁰ 16' E longitude and 600m MSL altitude. The areas are degraded forest lands and hilly country characterised by rugged topography with steep to gentle slopes and flat areas, lying on the eastern part of Western Ghats. The soils are mostly red and lateritic with pH ranging between 5.5 and 6.5. Soils are medium to deep with good drainage and moderate water holding capacity. The climate is of tropical monsoon type with an annual rainfall of 2200 mm that falls mainly between June and

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[1] Deputy Manager (Research)
[2] Deputy Conservator of Forests (Research and Development)
[3] Conservator of Forests
[4] Additional Prinicpal Chief Conservator of Forests

September months, followed by light rains during October and November and prolonged dry period. The maximum temperature is about 36^0 C. and the minimum temperature is about 16^0 C.

(b) *Provenances tested* : Details of locality of provenances tested are given in Table 1.

Table 1

Particulars of provenances tested.

Sl.	Provenance	Latitude	Longitude	Altitude (m msl)	Seed lot No.
	Pinus caribaea var.*hondurensis*				
1.	13H Queensland	18^0 12' S	145^0 57' E	45	61/85
2.	4H Queensland	18^0 12' S	145^0 54' E	30	62/85
3.	Cafma BC, Brazil	-	-	-	-
4.	Tierra Blanca (SB). Hond.	-	-	-	H/8/87
5.	San Antonio Decortes. Hond.	-	-	-	H/7/86
6.	Guanaja. Hond.	16^0 28' N	85^0 54' W	2	H/8/86
7.	Brus Laguna. Hond.	15^0 45' N	84^0 40' W	12	H/12/84
8.	Los Limones.Hond.	14^0 03' N	86^0 42' W	660	H/9/87
9.	La Brea. Hond.	15^0 45' N	85^0 58' W	400	H/11/87
10.	Agalteca. Hond.	-	-	-	H/6/87
11.	Yojoa. Hond.	-	-	-	H/5/86
12.	Culmi. Hond.	15^0 06' N	85^0 37' W	442	H/10/87
13.	Poptun Peten. Gautemala.	16^0 21' N	89^0 25' W	475	2/85
14.	Mt. Pine Ridge. Belize.	16^0 58' N	88^0 00' W	500	17/85
	Pinus tecunumanii				
1.	San Raefel Ridge. Belize	-	-	-	-
2.	San Esteban. Hond.	15^0 11' N	85^0 39' W	1200	H/2/86
3.	Ojo De Aguna. Hond.	15^0 20' N	86^0 52' W	1000	H/3/86
4.	Villa Santa. Hond.	14^0 14' N	86^0 19' W	1000	H/1/87
5.	Gulaco. Hond.	15^0 18' N	86^0 10' W	745	H/3/87
6.	La Sampedrana. Hond.	-	-	-	H/4/87

Notes :

P. caribaea var *hondurensis :*

Provenances 1, 2, 3 were tried in locality, Malalimath.

Provenances 4 to 14 were tried in locality, Varakodu.

Seeds for provenances No.1, 2, 13 and 14 were supplied by OFI, UK.

Seeds for provenances No. 3 were personally brought by Shri Adappa, B.S. the then C.F.(R).

Seeds for provenances Nos. 4 to 12 were supplied by Director, Banco-de-Seminillas (Seed Bank), Dpto-de-Comayagna, Honduras.

P. tecunumanii :

These provenances were tried in locality, Varakodu

Seeds for No.1 were supplied by O.F.I., U.K.

Seeds for the provenances No. 2 to 6 were supplied by Director, Banco-de Semillas (Seed Bank), Dpto-de-Comayagna, Honduras.

(c) *Experimental layout* : The trials were laid out in Randomised Complete Block Design (RCBD). In *Pinus caribaea* var. *hondurensis*, one trial was laid out during 1986 at Malalimath involving three provenances and seven replications and another trial was laid out during 1988 at Varakodu involving eleven provenances and three replications. In *Pinus tecunumanii*, one trial involving 6 provenances and three replications was laidout in Varakodu during 1988. In all the trials the plants were planted at an espacement of 3m x 3m. At Malalimath each treatment comprised 25 plants arranged in a square plot of 5 plants x 5 plants and centre nine plants in each treatment were measured for growth parameters. At Varakodu, each treatment comprised 49 plants arranged in a square plot of 7 plants x 7 plants and centre 25 plants were measured for growth. Analysis of Variance (ANOVA) was carried out for plot mean data and F-test was used to test the significance of differences between seedlot means.

(d) *Management* : Seeds were sown in raised sand beds and germinated seedlings resembling matchstick were pricked-out and transplanted into 12 x 20 cm polythene bags. Potting mixture contained sand and red earth in 1:1 proportion with a pinch of Diammonium Phosphate granules in the middle of the bag and a spoonful of mycorrhizal soil. the seedlings were maintained in the nursery by regular watering, weeding and shifting for about 4 months. The seedlings were transported and planted in the experimental plot at the onset of monsoon (June).

In the field, preplanting operations consisted of clearfelling the rankgrowth and burning the clearfelled material, followed by ripping of soil at an espacement of 3m between lines with D-50 Bulldozer. The seedlings were planted at the onset of monsoon. After planting operations consisted of (a) applications of NPK 15 : 15 : 15 fertilizer at 50 g per plant in two split doses, scraping and hoeing one metre around

Table 2

Mean Plant height (cm) and Mean DBH(cm) assessed at different ages for the provenances of Pinus caribaea var. hondurensis tried at Malalimath during 1986.

Provenance		1987	1988	1989	1990	1991	1992	MAI
1. 4H QLD.	Ht.	52.2	183.8	369.2	501.1	677.1	805.0	134.0
	DBH	-	-	5.6	7.7	9.9	12.6	2.1
2. 13H QLD.	Ht.	63.7	198.4	377.4	515.3	673.7	793.0	132.0
	DBH	-	-	5.9	7.8	9.9	12.2	2.0
3. CafmaBC	Ht.	45.5	150.2	338.2	494.3	620.4	795.0	133.0
Brazil	DBH	-	-	5.1	7.3	8.9	11.8	2.0
F-Test	Ht.	*	*	NS	NS	NS	NS	
	DBH	-	-	NS	NS	NS	NS	
S.Ed.	Ht	6.57	14.54					
C.D.	Ht	14.33	31.71					

Note : * : indicates significance at the 5% level. NS : indicates non-significance at the 5% level
S.Ed : Standard Error of difference. C.D. : Critical difference.

plants and all along trenches, digging of soil one metre wide all along trenches, two weedings, and fire tracing works during first year, (b) digging one metre wide all along the trenches, two seedlings, application of 25 g NPK 15:15:15 fertilizer in single dose and fire tracing works during second year, (c) digging one metre wide all along trenches, two weedings and fire tracing works during third year and (d) only watch and ward and fire tracing works every year from fourth year till the end of rotation period of 12 years.

Results and Discussions

Pinus caribaea var. *hondurensis* : Height from first year and diameter at breast height (dbh) from third year, were measured every year during May-June period. The data recorded were tabulated in Table 2 for 3 provenances of *Pinus caribaea* var. *hondurensis* tried at Malalimath, in Table 3 for 11 provenances of *Pinus caribaea* var. *hondurensis* tried at Varakodu.

It may be observed that the differences

Table 3

Mean Plant height (cm) and mean DBH (cm) assessed at different ages for the provenances of Pinus caribaea var. hondurensis tried at Varakodu during 1988.

Provenance		1989	1990	1991	1992	1993	1994	1995	MAI
1. Mt. Pine Ridge	Ht.	71	207	396	527.0	765.0	926.0	1035.0	148.0
(Belize)	DBH	-	-	-	9.3	11.3	13.1	14.5	2.1
2. Tierra Blanca	Ht.	73	223	417	557.0	777.0	964.0	1077.0	154.0
(Hond)	DBH	-	-	-	10.1	11.8	14.3	15.9	2.3
3. San Antonio	Ht.	77	219	413	569.0	723.0	924.0	10.34.0	148.0
Decortes (Hond)	DBH	-	-	-	9.8	11.3	13.2	14.7	2.1
4. Guanaja (Hond)	Ht.	85	232	422	562.0	718.0	883.0	987.0	141.0
	DBH	-	-	-	9.6	11.1	12.7	13.9	2.0
5. Brus Laguna	Ht.	79	232	436	596.0	780.0	967.0	1075.0	154.0
(Hond)	DBH	-	-	-	9.9	11.6	13.3	14.7	2.1
6. Los Limones	Ht.	72	218	410	558.0	740.0	881.0	963.0	138.0
(Hond)	DBH	-	-	-	9.5	11.7	13.3	14.7	2.1
7. La Brea (Hond)	Ht.	96	256	444	616.0	788.0	977.0	1120.0	163.0
	DBH	-	-	-	10.6	11.8	13.4	15.3	2.2
8. Agalteca	Ht.	66	198	382	550.0	717.0	901.0	1069.0	152.0
(Hond)	DBH	-	-	-	9.6	11.2	13.4	14.8	2.1
9. Yojoa (Hond)	Ht.	81	217	397	557.0	745.0	915.0	1000.0	143.0
	DBH	-	-	-	9.7	11.2	13.2	14.3	2.0
10. Culmi (Hond)	Ht.	61	180	357	515.0	688.0	892.0	990.0	141.0
	DBH	-	-	-	8.7	10.6	12.8	14.9	2.1
11. Poptun peten	Ht.	60	175	367	542.0	718.0	890.0	1000.0	143.0
(Gautemala)	DBH	-	-	-	9.6	10.4	12.2	13.6	1.9
F-test	Ht.	***	***	*	NS	NS	NS	NS	
	DBH	-	-	-	NS	NS	NS	NS	
S.Ed	Ht.	5.2	13.2	22.2					
C.D.	Ht.	20.2	27.6	63.2					

Note : *** and * indicate significance at 0.1% and 5% levels.

in height were significant for first two years in the first trial at Malalimath, and for first three years in the second trial at Varakodu. In both the trials the differences in height narrowed down and became insignificant with advancing age. The differences in diameter were statistically insignificant in both the trials. The MAI data indicate that average rate of growth is similar for all the provenances indicating suitability of all the provenances to the locality. In the first trial 13H-Queensland provenance was the best, followed by 4H-Queensland provenance and Cafma BC Brazil provenance. Further, field observations indicated that Queensland provenances exhibit better stem-form and uniformity in stand growth compared to seed sources from Honduras, Belize and Brazil. This might be due to collection of seeds in Queensland from clonal seed stands and clonal seed orchards while seeds are collected in Guatemala and Honduras from natural growth. In the second trial Tierra Blanca and La Brea provenances are leading the list and ending with Yojoa and Poptun peten provenances. 13H and 4H-Queensland provinces, Mt. Pine Ridge provenance from Belize, and Brus Laguna, Los Limones, La Brea, Tierra Blanca, Agalteca and Culmi provenance from Honduras are recommended for planting in operational scale plantings.

Growth data when compared with the data collected in similar studies conducted earlier in other places within India, indicate that the growth is better in site conditions where this trial is conducted than the growth in other sites, probably due to line ripping of soil with Bulldozer. Das and Tavitayya

Table 4

Mean Plant height (cm), Mean DBH (cm) recorded at different ages for provenances of Pinus tecunumanii tried at Varakodu during 1988.

Provenance		1989	1990	1991	1992	1993	1994	1995	MAI
1. San Raefel	Ht.	79	226	403.0	553.0	735.0	782.0	1074.0	153.0
Ridge (Belize)	DBH	-	-	5.1	7.8	10.2	12.5	14.5	2.1
2. San Esteban	Ht.	55	151	298.0	447.0	599.0	744.0	883.0	126.0
(Hond)	DBH	-	-	3.5	6.0	8.1	10.4	12.0	1.7
3. Ojo De Agua	Ht.	78	221	383.0	473.0	674.0	817.0	960.0	137.0
(Hond)	DBH	-	-	4.9	6.9	9.4	11.3	13.6	1.9
4. Villa Santa	Ht.	91	248	417.0	573.0	732.0	911.0	983.0	140.0
(Hond)	DBH	-	-	5.3	8.1	10.3	13.1	14.4	2.1
5. Gulalco	Ht.	87	233	396.0	533.0	724.0	871.0	1026.0	146.0
(Hond)	DBH	-	-	4.7	7.2	9.9	12.6	14.3	2.0
6. La Sampredana	Ht.	64	184	329.0	447.0	583.0	638.0	857.0	122.0
(Hond)	DBH	-	-	3.8	6.1	8.4	10.3	12.0	1.7
F-Test	Ht.	**	**	***	***	***	***	***	
	DBH	-	-	***	***	***	*	*	
S. Ed	Ht.	8.3	14.8	17.8	20.0	25.0	48.0	39.0	
C.D.	Ht.	25.3	34.5	38.8	44.0	54.0	104.0	86.0	
S. Ed	DBH	-	-	0.3	0.4	0.4	0.8	1.4	
C.D.	DBH	-	-	0.6	0.9	0.9	1.8	3.0	

Note : ***, ** and * indicate significance at 0.1%, 1% and 5% levels.

(1982) have indicated that Los Limones (Hond) provenance was performing best at Koraput (Orissa) with MAI of 83 cm for height and 1.6 cm for DBH. Data given by Chowdhary *et al*. (1982) had indicated an MAI of 1.23 m for height and 1.9 cm for DBH at New Forest (Uttar Pradesh), MAI of 0.92 m for height and 1.21 cm for DBH at Kalinga (Orissa), MAI of 0.6 m at Arakku (Andhra Pradesh) for Honduras provenances. The MAI for Poptun peten (Guatemala) provenance was 1.68 m. for height and 1.04 cm for DBH at New Forest (Uttar Pradesh), 0.51 m for height at Koraput (Orissa) and 0.49 m for height at Arakku (Andhra Pradesh). Zeliang and Deorani (1982) reported an MAI of 1.28 m for height for Honduras provenance and an MAI of 0.95 m for Guatemala provenance in Nagaland (Kohima, Minkong, Wokha and Narongtongpii).

Pinus tecunumanii : Height from first year and DBH from third year were measured every year during May-June and the data collected are presented in Table 4.

The differences in height and DBH measured are statistically significant between the provenances tried. San Raefel Ridge, Villa Santa, Gulaco and Ojo De Agua provenances are performing almost similar but better than San Esteban and La Sampedrana provenances.

Under field conditions *Pinus caribaea* var. *hondurensis* is performing better than *Pinus tecunumanii*. *Pinus caribaea* var. *hondurensis* has dark green, dense and more foliage as compared to slightly pale green, sparse and less foliage in *Pinus tecunumanii*. The trees have better-form with less taper in *Pinus caribaea* var. *hondurensis* as compared to the trees of *Pinus tecunumanii* which have more taper. Flowering, fruiting and seeding had been noticed in *Pinus caribaea* var. *hondurensis*, while flowering has not been noticed in *Pinus tecunumanii*. This indicates that site conditions are good for the growth of *Pinus caribaea* var. *hondurensis* where as they are hotter for *Pinus tecunumanii* which grows in slightly higher altitudes in its native habitat. Therefore *Pinus caribaea* var. *hondurensis* is planted in large scale plantations and *Pinus tecunumanii* is grown on limited scale and as secondary species in slightly higher altitudes.

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SUMMARY

There is an ever increasing demand for long fibre forest raw material due to depletion of Bamboos by the paper industry in India. Fourteen provenances of *Pinus caribaea* var. *hondurensis* and six provenances of *Pinus tecunumanii* were tested in the site to find out the desirable provenances for higher and sustainable productivity. Growth parameters assessed indicated that the differences in height and dbh were not significant for the provenances of *Pinus caribaea* var. *hondurensis* while the

differences were significant for the provenances of *Pinus tecunumanii*. Growth comparison under field conditions indicated that the site conditions are ideally suited for the growth of *Pinus caribaea* var. *hondurensis* where as they are hotter than that of native habitat for *Pinus tecunumanii* and hence *Pinus caribaea* var. *hondurensis* is grown on large scale and *Pinus tecunumanii* is considered as secondary species. 4H and 13H Queensland provinces, Mt. Pine Ridge provenance from Belize, and La Brea, Brus Laguna, Los Limones, Tierra Blanca and Culmi provenance from Honduras of *Pinus caribaea* var. *hondurensis* are desired for higher and sustained productivity.

लुगदीकाष्ठ रोपवन लगाने के लिए पश्चिमी घाट के स्थानों में *पाइनस कैरिबिया* विभेद *होण्डुरेंसिस* तथा *पाइनस टेकुनुमनिआई* के स्थानज विभेदों का मूल्यांकन

के०एम० सतीशचन्द्र, जी०एस० करियप्पा, एस० नागराज व जी०के० सेनवा

सारांश

भारत में कागज़ उद्योग के लिए बांसों के खत्म होते जाने के कारण लम्बे रेशे वाले वन कच्चे माल की मांग निरन्तर बढ़ती जा रही है । *पाइनस कैरिबिया* विभेद *होण्डुरेंसिस* के चौदह स्थानज विभेदों और *पाइनस टेकुनुमनिआई* के छह विभेदों का परीक्षण स्थल में उन्हें लगाकर अधिक और दीर्घ समय तक उत्पादक रहने वाला वांछनीय विभेद ज्ञात करने के लिए किया गया । आकलित वृद्धि परिमापों से संकेत मिला है कि *पा० कैरिबिया* विभेद *होण्डुरेंसिस* के स्थानज विभेदों में ऊँचाई और वक्षोच्चता पर व्यास की दृष्टि से कोई खास अन्तर नहीं है परन्तु *पा० टेकुनुमा निआई* के स्थानज विभेदों में इस दृष्टि से सार्थक अन्तर है । क्षेत्र दशाओं में उनकी वृद्धि तुलनाओं से संकेत मिला है कि यहाँ की दशाएँ *पा० कैरिबिया* विभेद *होण्डुरेंसिस* के लिए आदर्शतः उपयुक्त हैं क्योंकि *पा० टेकुनुमनिआई* के देशज प्राकृतावास की तुलना में ये अधिक गर्म हैं और इसीलिए *पा० कैरिबिया* विभेद *होण्डुरेंसिस* को बड़े पैमाने पर उगाया जाता है और *पा० टेकुनुमनिआई* को उसकी द्वितीयक जाति ही माना जाता है । *पा० कैरिबिया* विभेद *होण्डुरेंसिस* क्वींसलैण्ड स्थानज से आए 4 एच और 13 एच, बेलिजे के मा० पाइनरिज स्थान विभेद, और होण्डुराज से आए लाब्रेआ, ब्रुस लगुना, लोस लिमोनेस टियरा ब्लांका और कलमी स्थान भेद अधिक और दीर्घकालिक उत्पादकता के लिए वांछनीय रहेगें ।

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EFFECT OF DOUBLE DITCH METHOD OF PLANTING ON GROWTH CHARACTERISTICS OF SOME FOREST TREE SPECIES

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Introduction

Soil working techniques are of vital importance in relation to conservation of soil moisture. Precipitation pattern, type of soils and topography are some of the important factors determining the soil working techniques (Ghosh, 1977). In low rainfall areas (100-150 mm) raising vegetative cover is a difficult problem. The success would depends upon the right choice of appropriate soil working techniques and the post plantation care. Selection of appropriate indigenous and exotic species and different soil working techniques varies from region to region.

Double ditch method is a new technique beneficial for low rainfall areas based on studies in field experiments. By this method the total surface area is increased, as a result, rain drop which falls on the double ditches stops there itself and does not take the shape of run-off. Very scattered reports are available in literature on the efficiency of soil working techniques in different edapho-climatic conditions related to conservation of moisture. In the present study, an attempt has been made to find out the efficiency of double ditch planting method in relation to growth of some forest tree species in some parts of Panna Forest Division, Madhya Pradesh.

Materials and Methods

The study area lies in the semi-arid Zone characterised by low irregular rainfall with extreme temperature. In general, soils are poor in organic matter. deficient in nitrogen, phosphorus and calcium.

In double ditch method, soil around the plant was dug up to 23 cm depth after planting in a pit. The dug up soil was tipped in keeping with the view of large slope and direction of the slope. The dug up soil was kept in the middle in the form of a bund keeping plant in the middle of it. The bund formed in such a way divides whole surrounded pit into two ditches.

In slopy areas, the mouth of the circular bund was kept open to facilitate water to accumulate in the both ditches.

Measurements adopted for the ditches are as follows :

(1)	Diameter of a circular bund	1m
(2)	Width of mouth of circular bund	30-38 cm
(3)	Length of middle bund	1m
(4)	Width of the middle bund	25 cm
(5)	Depth of the ditch	23 cm
(6)	Size of the 1st ditch	80x30x22 cm
(7)	Size of the 2nd ditch	80x30x22 cm

The first ditch makes a barrier for the

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** Tropical Forest Research Institute, Jabalpur (Madhya Pradesh) surface run-off which reduces the water velocity and stops soil erosion. The middle bund acts as obstruction for water velocity and provides stable support to plant. The second ditch enhances moisture around the root zone.

The trial was conducted at different forest ranges of Panna Forest Division (M.P.). The species planted includes *Dendrocalamus strictus*, *Tectona grandis*, *Phyllanthus emblica*, *Eucalyptus* sp., *Terminalia arjuna*, *Azadirachta indica*, *Dalbergia sissoo*, *Albizia procera* etc. Of these, *Tectona grandis*, *Dendrocalamus strictus* and *Phyllanthus emblica* are among common species planted at all the sites taken for experiment. The data on growth attributes like height and girth (at collar) of different species was recorded in 2 and 3 yrs old plantation raised at different sites.

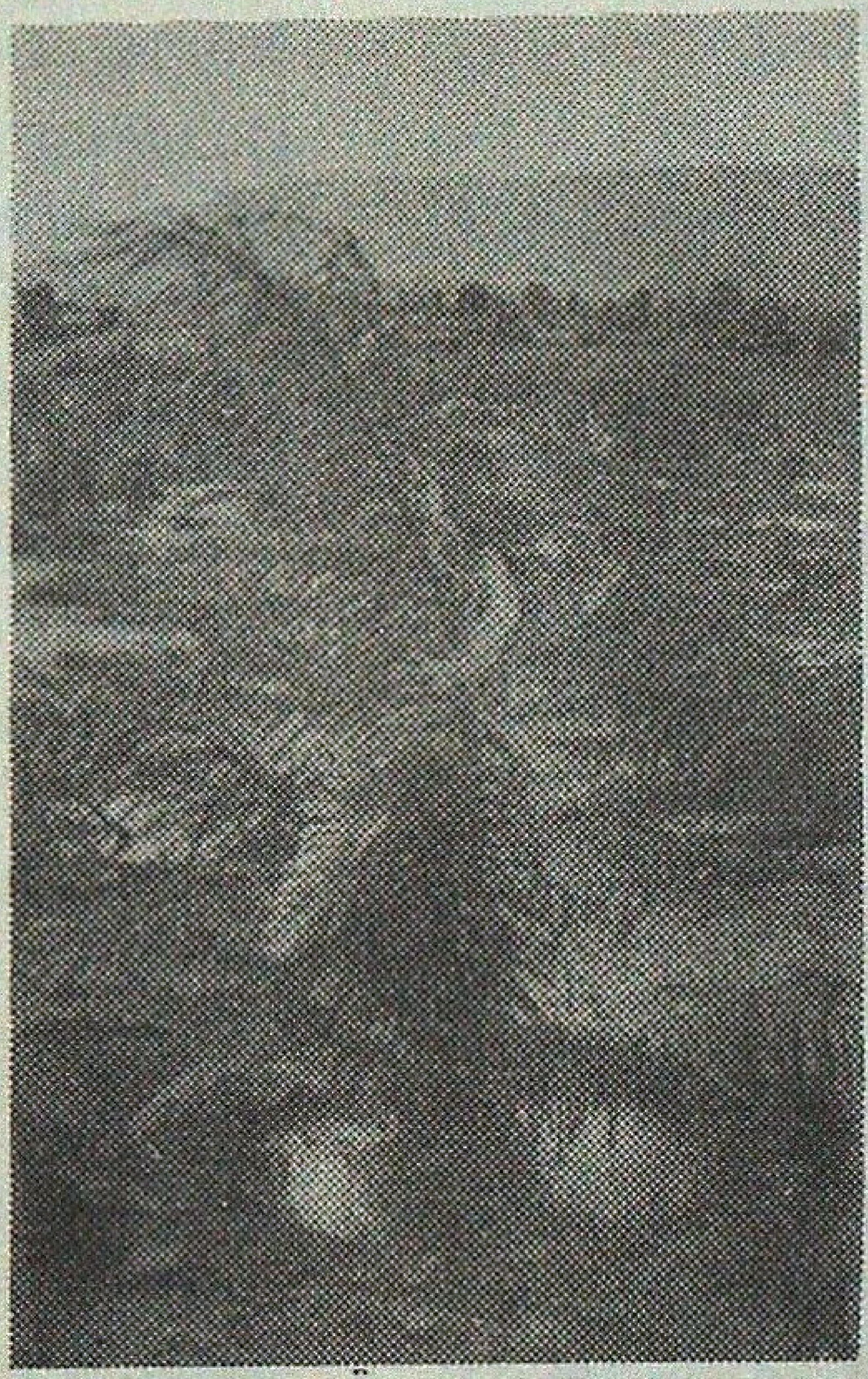
Results and Discussion

Table 1 and 2 show the responses of double ditch method on the growth attributes like height and girth (at collar) of different tree species in 2-years and 3-years old plantations. Analysis of data reveals that almost all the species planted at different sites responded well to this method of soil working in comparison to control. Critical examination of data presented in Table 1 and 2 reveal that the height of plants in double ditch method increased 2 to 3 times than that of plants in control. *Tectona grandis*, *Dendrocalamus strictus* and *Phyllanthus emblica* are the most promising species at all the sites studied (Figs. 1-3). In control, the height of teak at different sites varies from 0.10 (Mohendra) to 0.57 cm (Saleha) in 2-years old plantations and from 0.30 (Mohendra) to 0.87 cm (Saleha) in 3-years old plantations, whereas in double ditch method of soil working the height of teak varies from 0.33 cm (Mohendra) to 1.94 cm (Saleha) in 2-years old plantations and from 0.70cm (Mohendra) to 2.64 cm (Saleha) in 3-years old plantations raised at different sites. Similarly, minimum and maximum heights of *Dendrocalamus strictus* in control were 0.70 cm (Mohendra) and 1.74 cm (Shahnagar) in 2-years old plantations and 1.10 cm (Mohendra) and 2.32 cm (Saleha) in 3-years old plantations. Whereas in double ditch method, the plants of *D. strictus* attained heights between 1.76 cm (Mohendra) -3.30 cm (Saleha) in 2-years old plantations and between 3.10 cm (Mohendra) -4.15 cm (Saleha) in 3-years old plantations. In 2-years and 3-years old plantations at different sites, the heights of *Phyllanthus emblica* vary from 0.68 cm (Mohendra) to 1.11 cm (Amanganj) and from 0.75 cm (Mohendra) to 1.20 cm (Saleha) respectively in control, and from 0.91 cm (Mohendra) to 2.78 cm (Saleha) and 1.00 cm (Mohendra) to 3.11 cm (Saleha) respectively in double ditch method. Species like *Eucalyptus* sp, and *Azadirachta indica* also shown promising height growth at Shahnagar in 2-years old plantations.

It terms of collar girth, *Tectona grandis* proved to be most promising species towards double ditch treatment both in 2 years and 3 years old plantations raised at different sites. It was followed by *Phyllanthus emblica*.

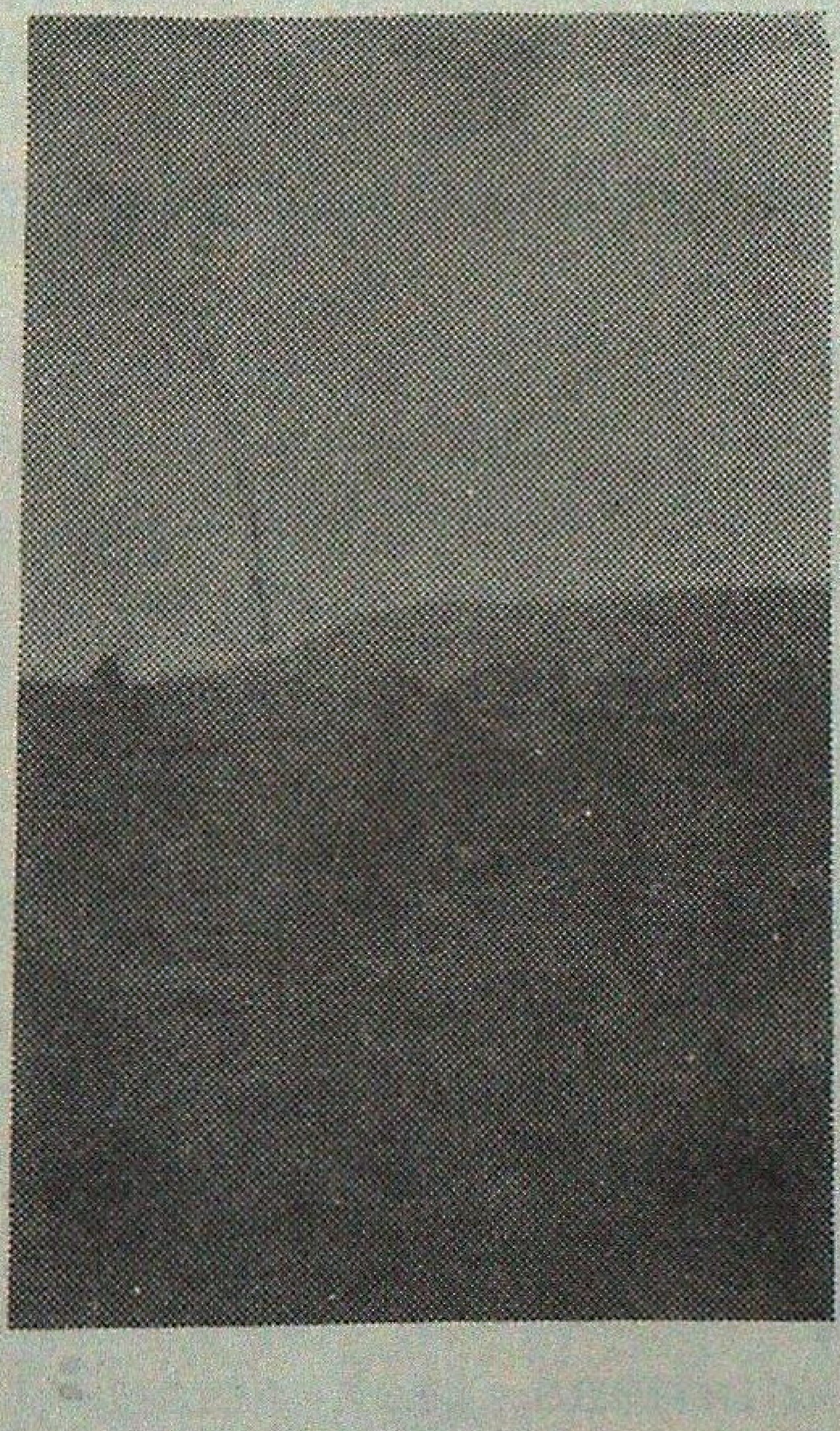
In 2-years old plantations, the collar girth of teak at different sites in control varies from 1.40 cm (Mohendra) to 8.90 cm (Saleha) and in double ditch treatment, it attained the girth from 2.90 cm (Mohendra to 16.60 cm (Saleha). However, in 3-years old plantations, teak attained 4.0 cm (Mohendra) to 8.5 cm (Saleha) in control and 8.7 cm (Mohendra) to 17.0 cm (Saleha) in double ditch treatment. This indicates

Fig. 1



One-year growth of *Emblica officinalis* in double ditches of soil working at Saleha site

Fig. 2



One-year growth of *Dendrocalamus strictus* in double ditches of soil working at Saleha site

Fig. 3

One-year growth of *Tectona grandis* in double ditches of soil working at Saleha site

Table 1

Responses of Double ditch method on height and girth of tree species in 2-yrs old plantations raised at different sites in Panna Forest Division

Site	Area (ha)	Species planted	Growth Attributes			
			Height (m)		Girth (cm)	
			Control	Double Ditch method	Control	Double Ditch method
Mohendra	50	*Dendrocalamus strictus*	0.78	1.76	2.30	2.90
		Tectona grandis	0.14	0.33	1.40	2.90
		Phyllanthus emblica	0.68	0.91	4.30	6.50
		Terminalia arjuna	0.65	0.95	6.40	7.00
Shahnagar	25	*Dendrocalmus strictus*	1.74	3.11	2.10	2.40
		Tectona grandis	0.10	0.34	2.00	3.50
		Phyllanthus emblica	0.89	1.21	6.40	8.40
		Eucalyptus sp.	1.47	2.32	7.60	13.40
		Azadirachta indica	0.63	1.23	5.00	7.50
Saleha	50	*Tectona grandis*	0.57	1.94	8.90	16.60
		Dendrocalamus strictus	1.31	3.30	3.50	6.40
		Phyllanthus emblica	1.00	2.78	8.50	17.90
Amanganj	25	*Phyllanthus emblica*	1.11	2.10	8.10	11.50
		Terminalia indica	1.02	1.52	10.50	13.80

Table 2

Responses of Double ditch method on height and girth of tree species in 3-yrs old plantations raised at different sites in Panna Forest Division.

Site	Area (ha)	Species planted	Growth Attributes			
			Height (m)		Girth (cm)	
			Control	Double Ditch method	Control	Double Ditch method
Mohendra	50	*Dendrocalamus strictus*	1.10	3.10	2.0	2.9
		Tectona grandis	0.30	0.70	4.0	8.7
		Phyllanthus emblica	0.75	1.00	4.8	9.3
Saleha	50	*Dendrocalamus strictus*	2.32	4.15	3.7	4.7
		Tectona grandis	0.87	2.64	8.5	17.0
		Phyllanthus emblica	1.20	3.11	7.7	19.7
Amanganj	50	*Phyllanthus emblica*	0.98	2.38	9.2	18.4
		Dalbergia sissoo	0.31	1.02	2.7	6.8
		Albizia procera	0.93	2.70	8.9	16.6

that in double ditch treatment, the collar girth increased 2-times than that of control. Similar findings of girth increments was observed in case of *Phyllanthus emblica*. The minimum and maximum collar girth of *Phyllanthus emblica* in control were found to be 43 cm (Mohendra) and 8.5 cm (Saleha) respectively in 2-years old plantations and 4.9 cm (Mohendra) and 9.2 cm (Amanganj) respectively in 3-years old plantations, whereas in double ditch treatment, *Phyllanthus emblica* attained the collar girth between 6.50 cm (Mohendra) -17.90 cm (Saleha) in 2-years old plantations and between 9.3 cm (Mohendra) -18.4 cm (Amanganj) in 3-years old plantations raised at different sites.

The fast and vigorous plant growth in double ditch method is primarily attributed to the fact that the total surface area is increased as a result of rain drops which fall on the double ditches stops there itself and does not take the shape of run-off. It is helpful in overall growth of plants. Profuse development of roots help plant grow faster by providing more nutrients from soil. Double ditches along with contour bunds and contour trenches help reduce soil erosion absolutely (Ram Prasad, 1988). Double ditch also reduces the cost of first and second weeding and also help in increasing the moisture retentions capacity of the soil, and thereby sustain the plant in adverse period.

SUMMARY

The paper deals with the efficiency of double ditch method of soil working related to the growth of some forest tree species planted at different parts of Panna Forest Division. The response of double ditch method have been recorded in terms of height and collar girth of plants. ***Tectona grandis*, *Dendrocalamus strictus*** **and** ***Phyllanthus emblica*** **are the most promising species responded to the double ditch treatment at almost all the sites taken for the study.**

द्विखाई रोपण प्रणाली का कुछ वानिकी प्रजातियों की वृद्धि विशिष्टता पर प्रभाव

बी०पी० नोन्हारे व ओ०पी० चौबे

सारांश

यह शोध पत्र पन्ना वन मंडल (दक्षिण) के विभिन्न भागों में कुछ वानिकी प्रजातियों पर द्विखाई प्रणाली से मिट्टी कार्य कर उसकी कार्यकुशलता का अध्ययन से संबंधित है द्विखाई प्रणाली के प्रभाव से पौधों की ऊँचाई एवं भू-सतह के समीप गोलाई में वृद्धि को रिकार्ड किया गया है । सागौन, बाँस और आँवला सफलतम ऐसी प्रजातियाँ हैं जिसमें द्विखाई प्रणाली का सभी स्थानों पर बहुत अच्छे परिणाम प्राप्त हुए हैं ।

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SEEDLING CONDITIONING FOR IMPROVED OUTPLANTING SURVIVAL IN CHIR PINE (*PINUS ROXBURGHII* SARGENT)

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Introduction

Chir pine the principal species in the lower Himalaya is a valued tree species yielding valuable timber, resin and other minor forest products. The usefulness of the species has led to overuse of chir forests and consequently reduction in their area and density. Natural regeneration appears in plenty in its natural habitat. However natural regeneration is prevented in the lower transitional belt by the invasion of *Dodonala viscosa* and *Carissa apaca* and in the upper transitional belt by *Quercus leucotrichophora*. Artificial regeneration is required in extensive blank areas even in the natural zone and in the transitional belts and outside its natural habitat. Being a pioneer species, It is less demanding on soil and nutrients than other conifers (Champion and Seth, 1968). It is, therefore, suitable for degraded sites. It forms the major species in afforestation programmes in its natural habitat.

The current practice for artificial raising of the species concentrates on the use of polybag grown seedlings to minimise transplanting shock, to which the species is highly susceptible. This technique adds significantly to the cost of raising plantations. Extra expenditure includes the cost of polybags, labour for filling that of shifting, and for transportation of bagged plants on mountain slopes being planted. The purpose of the present study was to overcome the use of polybags to investigate a cheaper method, conditioned bare-root seedlings. It involved research into conditioning treatments i.e. undercutting/ wrenching, lateral/box pruning, and irrigation intensities.

Materials and Methods

Two experiments (for monsoon and winter plantings) were laid out in a split-split plot design with two replications in the nursery and plantations area of College of Forestry, UHF, Nauni, Solan (H.P.). The study area is situated at an elevation of about 1250 m amsl and receives about 1000 mm rainfall of which about 800 mm occurs during monsoon months. The seedlings were grown at 13 cm x 13 cm spacing in 25 cm raised beds. The beds were brick lined to maintain the depth of undercutting. There were 162 beds of 1.5 m x 0.8 m size in each experiment. Seven month old seedlings were subjected to different combinations of undercutting depths, wrenching regimes, lateral prunings and controlled irrigation. Nine combinations of irrigation and wrenching (three irrigation levels - irrigation just after fortnightly wrenching, 12 hours after fortnightly wrenching and 18 hours after fortnightly wrenching and three wrenching levels - control, weekly and biweekly) were randomised in main plots followed by three undercutting depths (7 cm, 12 cm and 17 cm) in sub-plots and three lateral prunings (control, side pruning at 6 cm and box pruning at 6 cm from seedlings) in sub-sub plots. There were 6 wrenchings at weekly interval and 3 wrenching at biweekly interval.

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Undercutting and wrenching treatments were executed with blades mounted on a trolley on four wheels (locally fabricated using angle iron). The blades were attached to two reciprocating movable hollow steel rocker arms attached to the trolley. The depth of undercutting and wrenching was adjusted by sliding up or down the pivot point of the rocker arms. Sharpen thin band saw steel blades of narrow width fitted to work parallel to the bed surface were used for undercutting roots by executing reciprocating movements while the trolley was pushed forward. Wrenching was effected with a grill iron rod sharpen on one edge to give 12^0-20^0 angle when attached horizontally to the rocker arms of the trolley. The bricks holding soil above ground level were removed at the time of first undercutting. Lateral and box pruning operations were manually performed by inserting sharp steel band saw knives (30 cm length) upto 20 cm in the beds.

Seedlings were provided a rest period of four weeks after final wrenching treatment before being lifted for field planting. Seedlings were lifted on the day of field planting, bundled and transported manually over 1.5 km to plantation site in gunny bags. Seedlings were then planted in 30 cm x 30 cm x 30 cm pits at 1.5 m x 1.5 m spacing maintaining layout and design of the nursery experiments. Data on survival were recorded after one year of planting and were treated by analysis of variance. Survivals were arc sine transformed.

Results and Discussions

Restricted irrigation : There was a positive trend in survival rates with increasing delay in irrigating seedlings. The literature on the nursery practices on conifers (Aldhous, 1972; Anon. 1957; Chavasse and Weston, 1969; Darby, 1962; Rook, 1972) show that preconditioning of seedlings by restricted watering in the nursery can prepare them for dry spells in the field. In some countries alternative method of conditioning by restricted watering (Goor and Barney, 1968) is used for improving survival after transplanting. Abode and Sandi (1983) found that plants subjected to watering once every nine days were the hardiest. Nursery beds in the present study were watered to field capacity before initiating root culturing procedures to facilitate movement of the blade through the beds. The restriction on watering after wrenching, thus, may not have been severe enough to induce significant morphological and physiological changes to enhance the outplanting survival of the seedlings.

Wrenching treatments : Wrenched seedlings in the present study produced higher survival rates. Higher root-shoot ratio, induced by the optimum conditioning (Dhiman, 1991) is likely the major factor in promoting successful establishment of bare root seedlings. Findings of this study are in agreement with the findings of Bacon and Hawkins (1977) who observed that conditioning nursery grown Caribbean pine seedlings by partial root removal *in-situ* greatly enhances their field performance and permits their bare root planting. Previously bare root plantings of Caribbean pine like chir pine had failed both locally and elsewhere (Briscoe, 1962; Lamb, 1973), presumably because the seedlings were inadequately conditioned in the nursery to withstand the water stress associated with transplanting. Later studies have conclusively indicated that seedlings frequently root wrenched withstand drought to a greater degree than non-conditioned stock (Bacon, 1978). Root wrenching in the nursery also caused a marked improvement in the survival of other conifers after transplanting (Cameron and Rook, 1969; Rook, 1969; van Dorsser, 1970; Tanaka *et al.*, 1976; Benson and Shepherd, 1977).

Undercutting depth : The data presented in Table 1 indicate that an undercutting depth of 12 cm provided greatest survival rates on field outplanting. Undercutting at shallow depths probably stressed the seedlings too severely, resulting in lower survival rates. Undercutting at 7 cm depths does not appear to be suitable as seedlings experienced high mortality i.e., about 40 per cent in the nursery beds after treatment, possibly due

Table 1

Effect of different conditioning treatments on survival (%) of outplanted seedlings

Planting season	Conditioning Treatment			SEm	CD	
					0.05	0.01
		Irrigation				
	Immediate	After 6 hrs	After 12 hrs			
Monsoon	41.29	43.00	46.16	3.98	NS	NS
	(45.17)	(47.31)	(50.69)			
Winter	39.82	37.07	49.71	4.13	NS	NS
	(42.22)	(40.72)	(56.67)			
		Wrenching Frequency				
	Control	Weekly	Biweekly			
Monsoon	28.68	51.50	50.27	3.98	-	18.93
	(27.08)	58.33)	(57.73)			
Winter	27.68	51.07	47.86	4.13	-	19.60
	(27.78)	(58.15)	(53.70)			
		Undercutting Depth				
	Control	7 cm	12 cm			
Monsoon	40.31	47.10	43.00	1.66	5.42	-
	(43.06)	(52.55)	(47.55)			
Winter	39.88	43.50	43.22	2.71	NS	NS
	(43.33)	(48.49)	(47.78)			
		Lateral Pruning				
	Control	Lateral	Box			
Monsoon	42.46	42.84	45.14	2.20	NS	NS
	(46.76)	(46.06)	(50.32)			
Winter	44.79	40.37	41.43	2.11	NS	NS
	(50.75)	(44.44)	(44.45)			

- Values in parentheses are original means and those outside are transformed means (arc sine transformation) to severe shock or drag and drastic reduction of root mass. As mentioned earlier the machine used had its limitations and it was not always possible to achieve a clean shallow severance of the tap root without disturbing the remaining root system. Donald and Simpson (1985) observed that shallow undercutting (10 cm) does not influence survival of interior spruce, sitka spruce, Lodgepole pine and Douglas fir seedlings over the normally conditioned (20 cm) seedlings. Undercutting at greater depth (17 cm) expressed low survival on field planting probably due to insufficient conditioning of the stock. van Dorsser and Rook (1972) also observed that radiata pine seedlings undercut at greater depth do not condition sufficiently.

Lateral pruning treatments : Outplanting survival rates of seedlings did not appear to be affected by lateral root pruning, although box pruned seedlings showed a mean survival greater than the unpruned and side pruned seedlings. Watson and Syndor (1987) hypothesised that lateral pruning should help in increasing outplanting survival and reduce the dry weight of lateral roots, but this did not prove true for loblolly pine seedling. Venator (1983) found that lateral root pruning of seedlings both across and along the bed at 2, 4, 6 and 8 week intervals, failed to stimulate new roots on the first 15 cm of non-undercut length of taproots in nurseries of long leaf pine.

In these trials, root pruning and undercutting/wrenching, were not carried out in the New Zealand fashion described by van Dorsser and Rook (1972), due to a lack of equipment to effect these procedures with precision. Seedlings in the present study were lateral pruned at 6 cm distance from seedlings compared to 8 cm as practiced for radiata pine (van Dorsser and Rook, 1972). The literature also states that if the pruning is carried out deeper than 5 to 8 cm, the effectiveness of the treatment is diminished (Bunting and McLeod, 1984). The depths of pruning in these trials was kept 10-20 cm and the extent to which this may have reduced the effectiveness of the treatment needs further investigation.

Of the range of treatments investigated in this study it appears that wrenching frequency has had the most positive effect on survival rates in the forest. Frequent wrenching increase soil porosity and encourages fibrous root development. It is postulated that this may be the reason for the result obtained. For wrenching to be effective, on heavy soils especially, it is important that it is preceded by a shallow undercut, which has to be carried out at optimum soil moisture levels and in a manner that does not disturb the remaining root system.

SUMMARY

In two experiments on conditioning of chir pine (*Pinus roxburghii* Sargent) laid out to raise seedlings for monsoon and winter plantings, seven month old seedlings were subjected to three undercutting depths (7 cm, 12 cm and 17 cm) followed by three wrenching regimes (control, weekly and biweekly) and combination of lateral and box pruning (control, lateral pruning at 6 cm and box pruning at 6 cm from seedlings) and three irrigation intensities (irrigation just after fortnight wrenching, 12 hours after fortnight wrenching and 18 hours after fortnight wrenching). The experiments were laid out in split-split plot design with two replications. Treated plants on providing a rest period of four weeks after final wrenching were outplanted in field at 1.5 m x 1.5 m spacing. Different treatment combinations exhibited varying responses on survival of the outplanted seedlings,

recorded after one year. Wrenching frequency significantly improved survival of seedlings. Maximum and highly significant survival was recorded in seedlings wrenched weekly followed by those wrenched fortnightly. Undercutting depth also significantly influenced outplanting survival. Maximum survival was recorded for seedlings undercut at 12 cm followed by those undercut at 17 cm. The results of treatments-lateral pruning, box pruning and irrigation showed non-significant effects on field survival rates.

सामान्य चीड़ (*पाइनस रौक्सबर्धिआई* सार्जेण्ट) की परिष्कृत बहिर्रोपण अतिजीविता के लिए पौधों का दशा प्रभावन

आर०सी० धीमान, एन०के० जोशी व जाप वान डोरसर

सारांश

मानसून और शीतकालीन रोपण के पौधे उगाने के लिए सामान्य चीड़ (*पाइनस रौक्सबर्धिआई* सार्जेण्ट) के पौधों के प्रभावन पर किए गए दो संपरीक्षणों में जिनमें सात मास के पौधों को नीचे की तरन तीन गहराइयों.पर (7 सेमी०, 12 सेमी०, 17 सेमी०) काट दिया गया था, उसके बाद तीन तरह प्रकुंचन (नियामक, साप्ताहिक, पाक्षिक) किया गया, पार्श्विक और बक्स कटाई-छंटाई का संयोग (नियामक, पार्श्विक कटाई-छंटाई 6 सेमी पर तथा बक्स कटाई-छंटाई पौधों से 6 सेमी० पर) और तीन सिंचाई चण्डताएँ (पाक्षिक प्रकुंचन के तुरन्त बाद, पाक्षिक प्रकुंचन के 12 घंटे बाद और पाक्षिक प्रकुंचन के 18 घंटे बाद) कराया था, किया गया । संपरीक्षण विभक्त भूखण्ड आकल्प किया गया जिसमें दो दुहराव किए गए । उपचारित पौधों को अन्तिम प्रकुंचन के पश्चात् चार सप्ताह का विश्राम देकर उन्हें 1.5 मी० x 1.5 मी० का फासला छोड़कर क्षेत्र में बहिर्रोपित किया गया । विभिन्न उपचार संयोगों की बहिर्रोपित पौधों की अतिजीविता पर विभिन्न प्रकार का प्रतिचार होता देखा गया जिसका अभिलेखन एक वर्ष बीत जाने पर किया गया । प्रकुंचन की बारम्बारता ने पौधों की अतिजीविता पर सार्थक सुधार होता दिखाया और अधिकतम और अत्याधिक सार्थक अतिजीविता उन पौधों में आलेखित हुई जिनमें साप्ताहिक प्रकुंचन किया गया था, इसके बाद वे पौधे रहे जिनका पाक्षिक प्रकुंचन किया गया था । नीचे से काटने की गहराई का भी बहिर्रोपितों की अतिजीविता पर सार्थक प्रभाव रहा । अधिकतम अतिजीविता उन पौधों की रही जिन्हें 12 सेमी नीचे काटा गया था, उसके बाद वे जिन्हें 17 सेमी गहराई पर काटा गया था । पार्श्विक कटाई-छटाई और बक्स कटाई-छंटाई और सिंचाई करने के उपचारों के परिणाम क्षेत्र अतिजीविता दरों पर असार्थक प्रभाव डालते पाए गए ।

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PROPAGATION AND GROWTH STUDIES OF *CALLIGONUM POLYGONOIDES* (PHOG)

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Introduction

The *Calligonum* genus has about 60 species of shrubs and small trees distributed in the desert regions of North Africa, Western Asia and Southern Europe. *Calligonum polygonoides* Linn. is the only species occurring in India. The biggest division of Western Indian desert is termed as sand dune areas (arid areas) and is demarcated vegetationally by *Calligonum* type of vegetation. The demarcation of the arid and semi-arid regions are mainly based on distributional pattern of *Calligonum* plants, whereas more emphasis is given on the presence and absence of a leafless xerophytic shrub, *Calligonum polygonoides.* (Charan and Sen, 1979). It shows the monoclimax tendency by its succession only over sand dune areas.

This is a shrub highly adapted both physically and physiologically to desert condition. Plant although absolutely leafless yet is highly useful for both man and nature. The plant is non-succulent and true xerophyte. Plant supplies not only food and wood but also has high soil binding capacity through its extensive root system which hips in stabilization of sand dune. However, this nature's gift had been exploited by human beings for their greed. An example for its extensive exploitation is that 20 to 30 truck load of roots of *Calligonum* could be seen coming to Bikaner town every day where this is the main source of supply of firewood and charcoal (yield 18.9 kg per plant). Man with his axe and his herd of goats and camels is taking main role in destroying the plant thereby abating the march of desert. The whole Rajasthan would have become complete desert but for the presence of this plant. Prevention of this can be done by planting this nature's gift i.e. *Calligonum* plant. It is the most important of all the desert shrubs.

During the hot summer, the animals seek green vegetation most and cattle eat even the green shoots of phog, ker, etc. which are normally unacceptable to them. Phog provides the stock with sustenance diet through the long dry period. Flowers of phog are also used as vegetables.

Technical know how is necessary before taking up the planting work. Since literature regarding propagation and growth of the plant is not available, present study has been taken up.

Seed Collection

Most of the seeds in Indian desert are brownish yellow to dark brown colour. The flowering in phog occurs profusely in Feb.-

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March. The flowers are yellowish-pink in colour. The very small (6-8 mm long) seeds are borne inside the flower. Phog seeds are brownish yellow. The seeds ripen in the month of late march or April, when the colour of the flowers become brownish. The seeds are densely clothed with reddish-brown bristles, are non-endospermic and are dispersed by wind and water. *Calligonum polygonoides* is normally shrub but also grows into trees. Therefore the phog seeds can be picked up or collected by hand.

Materials and Methods

1. *Germination experiment* : Fresh seeds were collected from Bikaner in the month of April and stored in plastic container. Fresh seeds were subjected to pretreatment as mentioned below :

(i) Soaking in water at room temperature.
(ii) Soaking in chilled water at 4°C to 8°C.
(iii) Treatment with conc. Sulphuric Acid for 5 minutes and thoroughly washing in running water to remove the traces of acid.
(iv) Control.

In the second experiment, the seeds were sown in 0.5, 1.0 and 1.5 cm depth in germination trays with sand and soil (2:1) as medium to see the effect of depth on germination rate and percentage. In the third experiment, seeds were sown in different moths from May to Nov-1991 to see the periodical effect of germination on germination rate and percentage.

100 seeds for each treatment, in 3 replicates were taken for each experiment. After treatment the seeds were transferred for germination. Rate and percentage of germination was recorded regularly.

2. *Vegetative propagation* : Vegetative propagation of branch cuttings were taken up during the month of Aug. The cuttings 20 to 25 cm long and 2 to 4 cm thick were treated with Indole Acetic Acid and Kinetin with 3 conc. of 100, 150 and 200 ppm.

The cuttings were soaked in solutions for over night and transferred to polybags and sprouting and rooting were observed. Fifty cuttings for each treatment and control were taken.

3. *Growth studies* : One hundred and fifty seedlings raised in polybags were planted in experimental plots at a spacing of 2x2 m^2. The pit size was 45cm^3 for each plant. Initial height was measured at the time of planting. Seedlings were watered initially once in two days till the establishment. Every six months the height of plants were measured and 3 plants with their root systems were excavated. Root and shoot, fresh and dry weights were measured for determination of biomass.

Results and Discussions

Results expressed are from average of three replications in all the experiments.

Germination : Table 1 shows the results of deed pretreatment. The germination is better in the untreated and the seeds soaked in water at room temp. Time taken for starting germination and completing germination is same in both treated and untreated ones but percentage of germination is higher in seeds soaked in water and untreated ones. Therefore, *Calligonum* seeds do not require any special pretreatment for enhancement of rate and percentage of germination.

Table 2 show that 0.5 and 1 cm depth

Table 1

Effect of seed treatment on germination of Calligonum polygonoides.
(Figures show the average of triplicate)

Treatment	Germination (%)	Mortality (%)	Germination Start (days)	Germination Completion (days)
Control	50.0	Nil	11	32
Soaking in water for 12 hrs.	50.0	Nil	10	27
Soaking in chilled water (4-8ºC)	33.3	Nil	10	27
Acid scarification Conc. H_2SO_4 - 5 mins.	30.6	Nil	12	30

Table 2

Effect of depth on germination of Phog seeds

Depth in (cm)	Germination (%)	Mortality (%)	Time taken to start germination (days)	Time taken in completing germination (days)
0.5	50	Nil	11	20
1.0	50	Nil	12	27
1.5	36	Nil	12	27

has given same percentage of germination but showed little delay in rate of germination in 1cm depth. So, 0.5 cm depth is good enough for better germination of Phog seeds.

Table 3 shows the rate and percentage of germination in different months. Germination percentage is more as the time increases from time of collection of seeds. It has reached peak in November and January without any mortality. Whereas in May and July germination percentage is less with more mortality which may be attributed to high temperature in the season. This study shows that Nov. to Jan. is ideal month for sowing and seedling will be 9-10 months old by plantation time i.e. around Aug-Sep. Seeds maintain viability for nearly two years. This shows that the seed can wait upto two years in nature in case of adverse condition.

Vegetative propagation : Initial studies in propagation of *C. polygonoides* by branch cutting showed 100 ppm or 100 mg/l were most effective in inducing rooting with both IAA and kinetin out of the 3 concentrations used in the experiment. Fig. 1 shows the effect of rooting with different concentrations of harmones and with control. Further studies were continued with different and lower concentration of harmone and rooting percentage in different season. This has observed that use of mist chamber in not necessary for inducing rooting in phog cuttings.

Table 3

Germination behaviour of Phog during different months

Time of sowing	Germination (%)	Mortality (%)	Germination Start (days)	Germination Completion (days)
May '91	29.7	64.4	7	30
July '91	30.0	17.6	6	60
Sept '91	45.0	**Nil**	10	38
Nov. '91	50.0	**Nil**	12	27
Jan. '92	50.0	**Nil**	11	27
May '92	35.0	15.0	12	30
Nov. '92	20.0	20.0	12	30

Growth studies : Rate of growth is fast in initial stages upto one year of planting and then slows down. The plant is of shruby nature, normally it reaches the height of 1-2 m and then growth may be slowed down which is one of the adoptive nature of the desert plant (Fig. 2)

Calligonum plant is shruby in nature, spread of side branches are more and have the bushy appearance. Initially the spread of canopy is very less. But with the increase of height, crown diameter also proportionately increases (Fig. 3). The plant shows the steady increase in the beginning and biomass is directly proportional to the height of the plant (Table 4).

Root biomass regression equation : From available data of seedlings the root biomass equation can be derived as below :

Let $M = Ah + Bh^2$

where M = root biomass (dry wt.); h = height of plant.

A and B are regression constants to be found out. Since we have three different datas of plants there will be three equations. Solving any two equations gave different values of A and B as below :

$A = 0.7309; 0.1967; 0.5633$

$B = 0.0115; 0.0055; 0.0091$

Taking out average values of A and B the equation becomes :

$$M = 0.4967\,(h) + 0.0087\,(h^2)$$

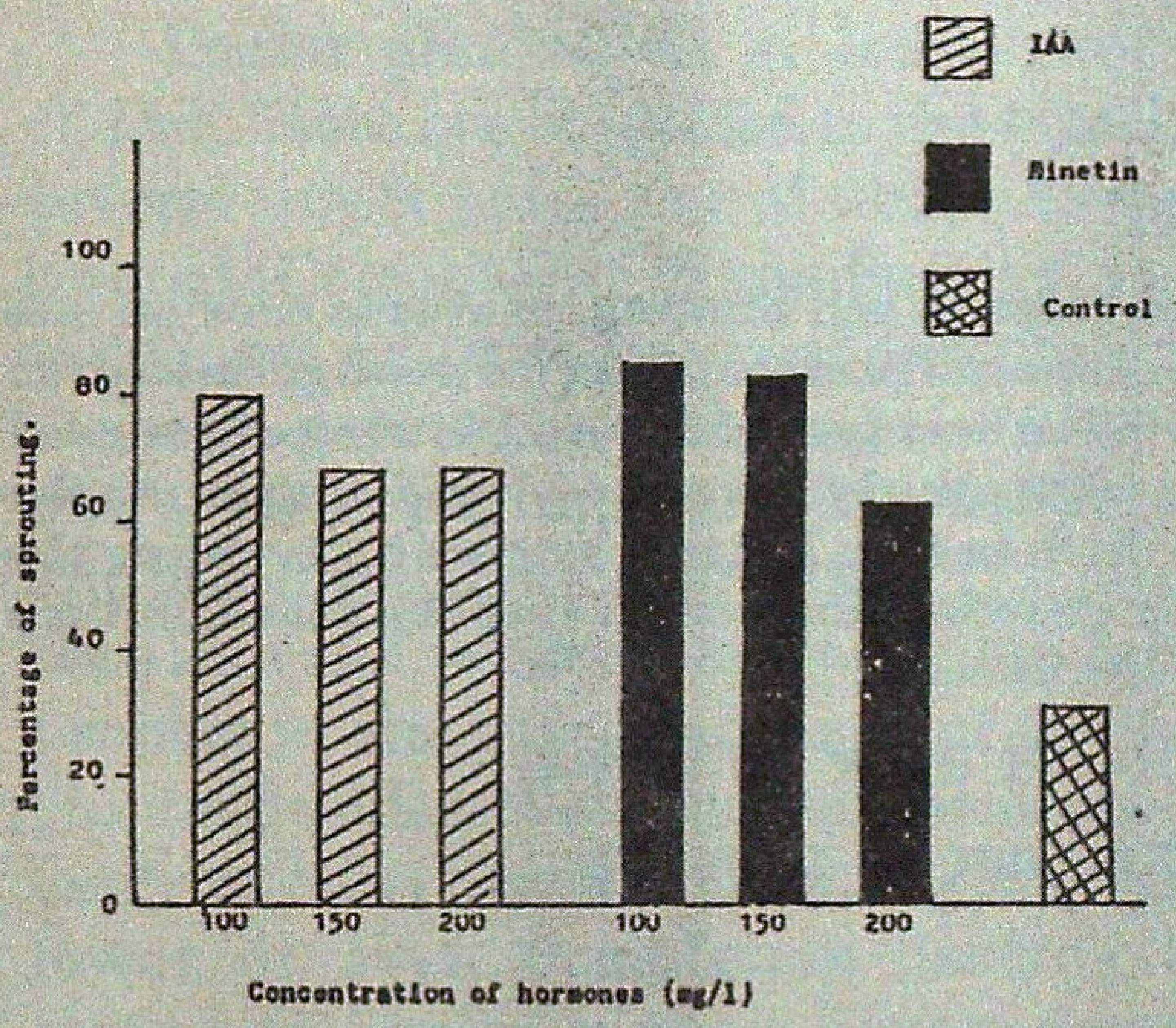
This equation explains the behavior of root biomass in initial stages and needs a final testing for future growth of plants. After the growth in height has stopped the root continues to grow which is typical behavior of desert plants in its endeavour to adopt local conditions. At that stage the equation will be suitably modified.

Table 4

Growth data of Calligonum polygonoides

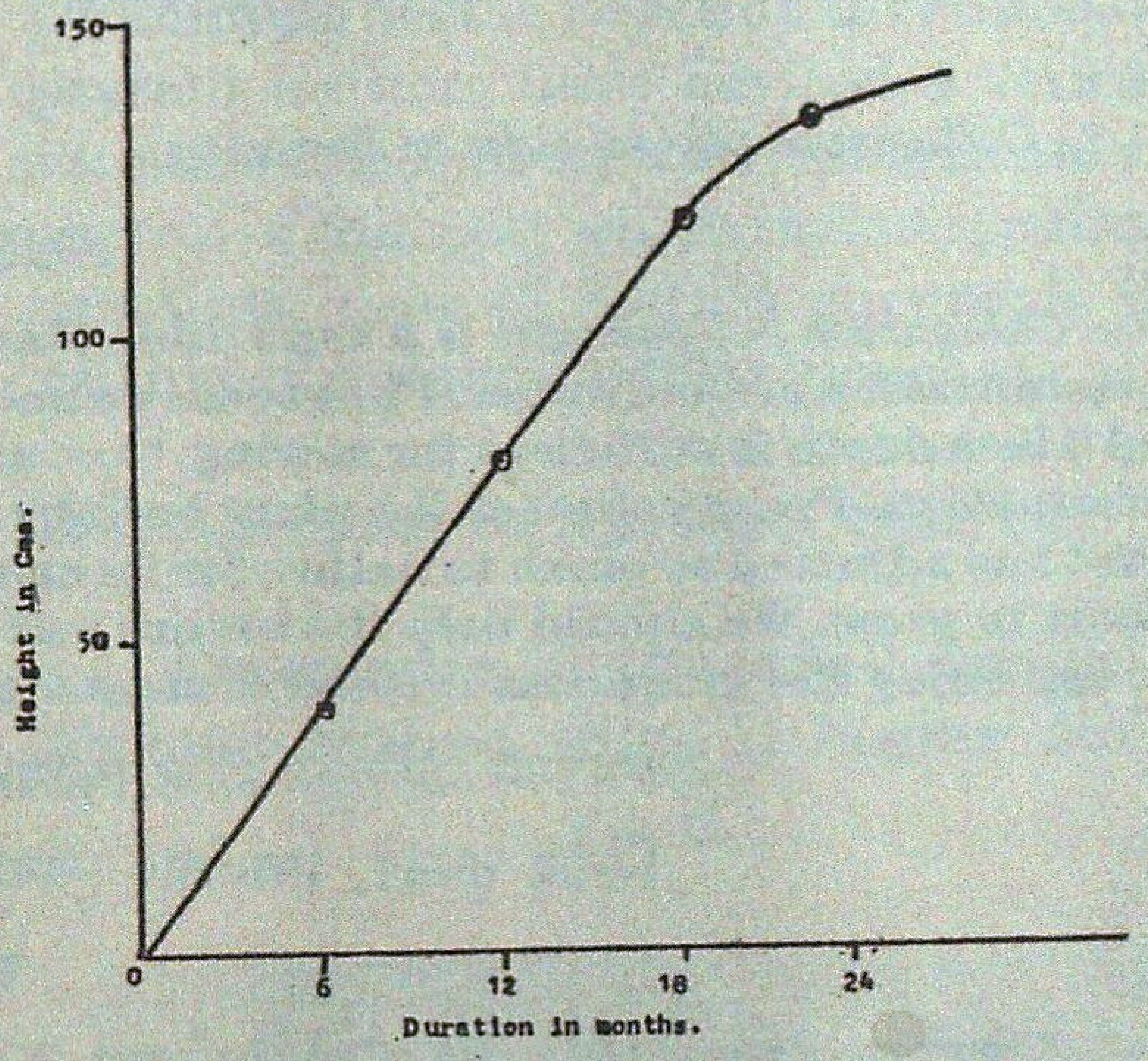
Sl. No.	1	2	3
Height of plant (above ground)	70 cm	154 cm	209 cm
Root length	58 cm	112 cm	170 cm
Shoot/root ratio	0.828	0.727	0.813
Crown diameter	24 cm	121 cm	225 cm
Fresh wt. of shoot	20.45 g	950 g	3200 g
Root	12.96	310 g	510 g
Dry wt. of shoot	8.34 g	490 g	1760 g
Root	5.19 g	160 g	280 g

Fig. 1



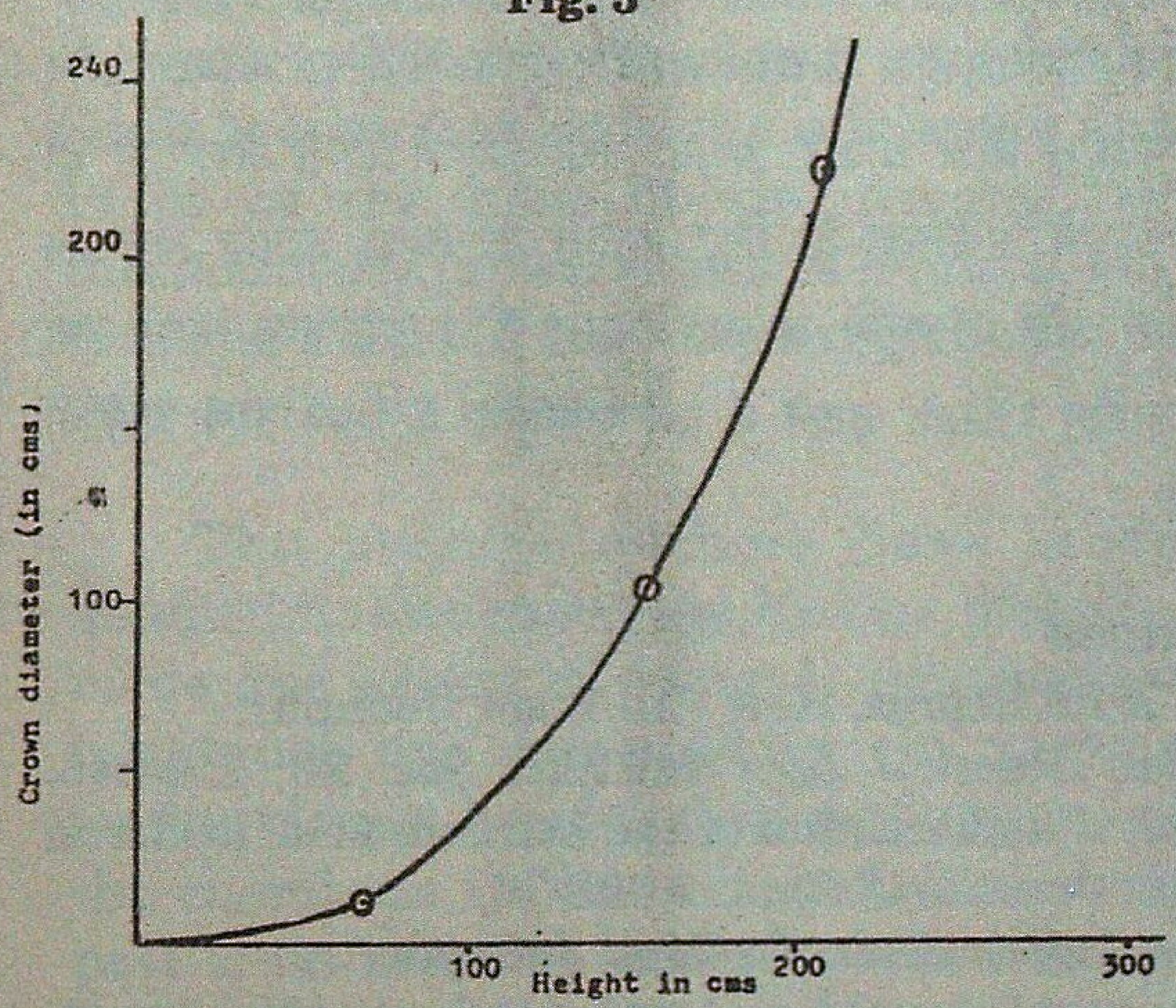
Influence of hormonal treatment on sprouting

Fig. 2



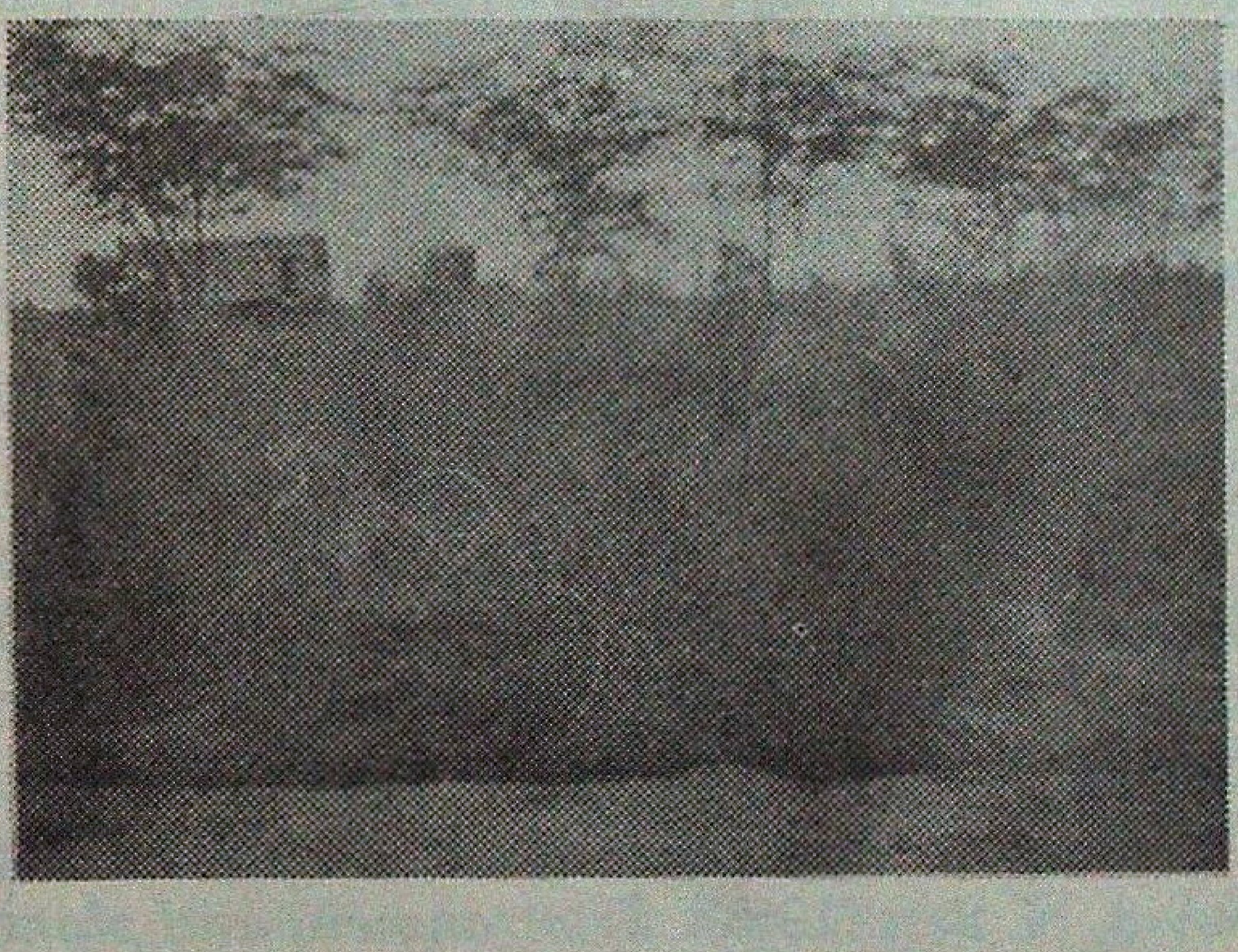
Initial growth rate of *Calligonum polygonoides*

Fig. 3



Relationship betweeen height and crown diameter

Fig. 4



Calligonum polygonoides - 2½ years old

Fig. 5

Calligonum polygonoides in flowering

Conclusion

The propagation of the plant is very simple. No special technique is needed for germination. It shows that as the plant is highly adjustable in nature except where the temperature is very high above 45⁰C, its offspring will also come up very easily without undergoing any special adoption. Afforestation of this plant is very easy. Silviculture and management is not a tough one which we have to take up without any difficulty.

SUMMARY

Calligonum polygonoides **is a sand dune plant which helps in soil binding, prevents erosion and in stabilization of sand dunes. Phog seeds do not need any special pretreatment for good germination and 0.5cm depth is sufficient for sowing. Nov. and Dec. is the best period for seed sowing of get good germination. Propagation of the plant both by seed or vegetatively is very easy and simple. As the plant has adjusted so much to nature for its existence which in turn help the nature by avoiding the desert to grow. We should help the nature and plant by growing and conserving the plant, in turn we can enjoy the greenness instead of sand storms in the desert.**

कैलिगोनम पोलिगनायडिस (फोग) के प्रवर्धन एवं बढ़वार का अध्ययन

विनोद कुमार, एच०सी० नागवेणी, देवेन्द्र कुमार व वेदपाल सिंह

सारांश

कैलिगोनम पोलिगनायडिस रेत टीलों का पादप है जो मृदा को बांधने, मृदा अपक्षरण रोकने में सहायता पहुँचाता है, तथा रेत के टीलों को स्थिर बनाता है। अच्छा अंकुरण कराने में फोग के बीजों का कोई विशेष पूर्वोपचार करने की जरूरत नहीं होती और उन्हें बोने के लिए ०.5 सेमी गहराई पर्याप्त है। अच्छा अंकुरण पाने के लिए नवम्बर और दिसम्बर में बोना सबसे अच्छा मौसम रहता है। पादप का प्रवर्धन बीज बोकर अथवा वर्धी उपायों दोनों तरह से हो जाता है और बड़ा सरल और आसान है। यह पौधा चूंकि अपने अस्तित्व के लिए प्रकृति के बहुत ज्यादा अनुकूल बन चुका है, बदले में यह प्रकृति को भी सहायता पुहँचाता है और मरूभूमि बढ़ना रोकता है। हमें यह पौधा उगा और इसे संरक्षित करके प्रकृति और पादप की मदद करनी चाहिए जिसके बदले में हमें मरूभूमि में आने वाली रेतीली आंधियों के बजाए हरियाली का आनन्द उठाने को मिलेगा।

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MANAGEMENT AND CONTROL OF *APRIONA CINEREA* CHEVROLAT (COLEOPTERA : CERAMBYCIDAE) A SERIOUS STEM BORER PEST OF POPLARS IN JAMMU FORESTS

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Introduction

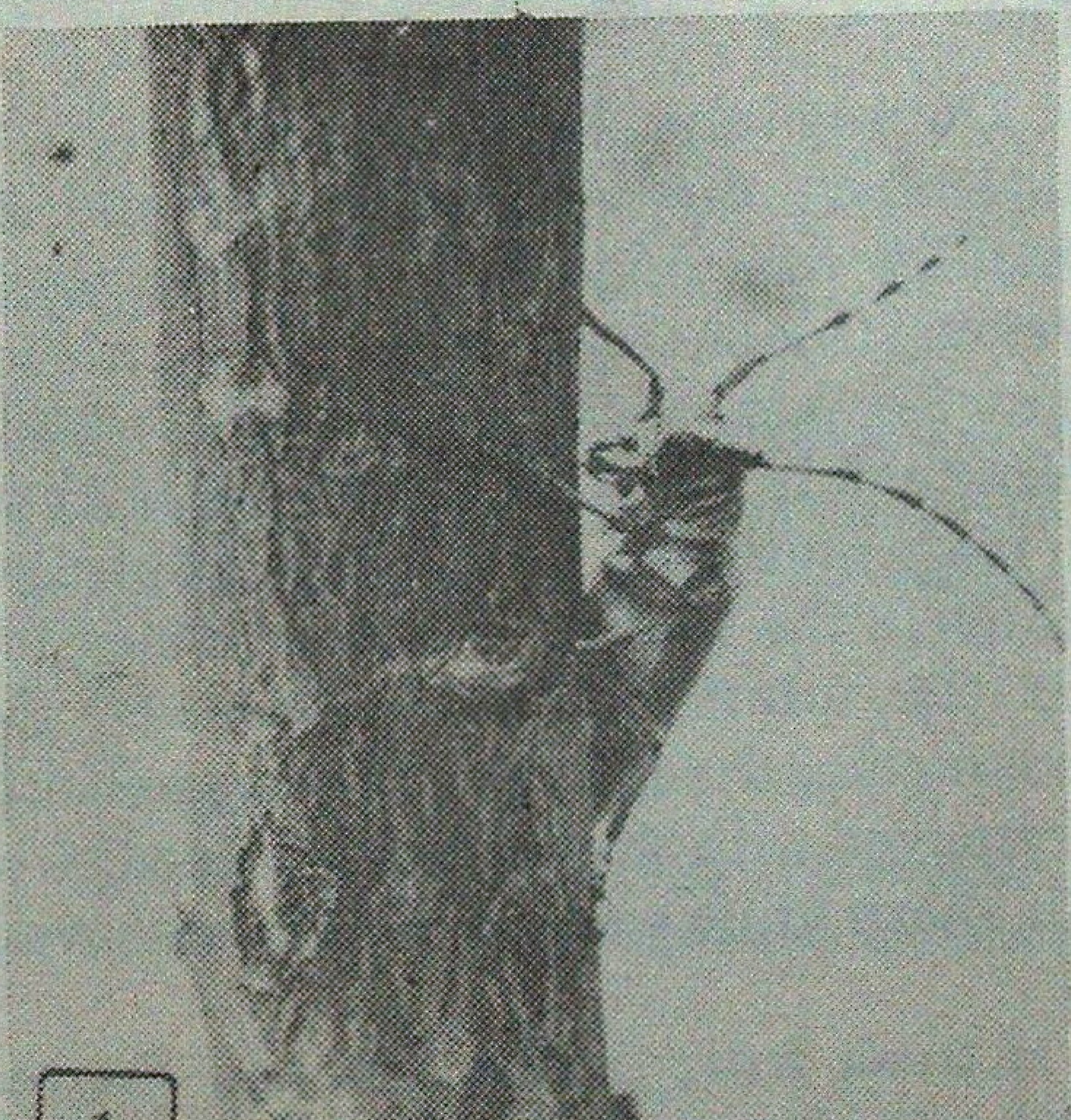
Poplar plantations in Jammu region of J&K State are subjected to the attack of several insect pests, out of which *Apriona cinerea* (Coleoptera : Cerambycidae) in its larval and adult stages has been observed causing devastating damage in nursery and avenue plantations along the length and breadth of Jammu province. The larvae bore into and ramify internal galleries and tunnels in the stem and roots of the host plants. Besides. these tunnels facilitate the entry of other pests and pathogens which lower or even completely destroy the commercial value of wood. Severe damage may result ultimately into large scale die back of the plantations. While the maximum damage is done by the larval stages, the adult beetles feed upon the soft leaves and twigs of the host plants. Among the commercially grown clones of Poplars, G3, G48 and EG 65/27 have been recorded to be very seriously infested.

The present authors have made detailed studies on ecology, biology, lifecycle, mode and extent of damage, comparative resistance and susceptibility in various poplar clones, besides field evaluations of the chemicals for their control. Since this pest is an internal feeder, it is extremely difficult to control it by external application of chemicals or for that matter any other cerambycid beetle. Based on the studies the present authors have devised a series of recommendations for the management and control of this pest which includes cultural practices, uses of certain chemicals and raising of resistant poplar clones.

Management of *Apriona cinerea*

Emergence of the adult beetles of *Apriona cinerea* (Fig. 1) begins during

Fig. 1



Apriona cinerea - adult beetle

middle to late July and continues till early to middle of September. Emergence is synchronized with the onset of summer rains, high humidity and high temperature.

The following practices may be adopted to destroy the beetle or minimize the losses caused by this insect.

Cultural Control

All the poplar plantation in the nurseries should be regularly examined specially during rainy season (between July to September) and any adult beetle seen on the plantation or in the surrounding area should be captured and killed. Beetles during day time usually remain hidden among the thickets of poplar foliage, clinging very tightly to the branches or may also be seen among the surrounding vegetation or in the crevices etc. During dusk these beetles get activated and can be seen on the branches and on the main bole, nibbling the host bark. Female beetles can be seen excavating egg niches for oviposition.

(a) During egg laying period (July-September) the plantations should be carefully examined daily during early morning. One should look for the egg niches about 3-4 feet above ground level on the main stem. In addition, nibbled up bark on the main stem and fallen twigs or girdled stumps in the vicinity is a clear indication that the adult beetles are active. On encountering the egg niches, the eggs should be removed with the help of fine needles or with sharp knife and should be destroyed.

(b) If fresh frass (moist bits and chewed wood mixed with excreta) is seen being ejected out from any stem among the plantations, the infested stump should be pruned or the boring larva should be traced out with the help of a sharp knife. The larvae will be close to the point of ejection of frass. On removing the larva, it should be killed.

(c) The plants which are very badly infested, should be uprooted and destroyed by burning soon after.

(d) In those nurseries from where cuttings of poplars are supplied to other forest nurseries, or for field plantations or to the farmers, a quarantine unit is needed which should inspect each and every cutting for the infestation of *Apriona cinerea* and all those cuttings which are found infected should be destroyed and not transported to other stations. Similarly all plants and cuttings which are received from outside should be thoroughly examined for the attack.

Chemical Control

Besides these preventive measures, the infestation can be minimized even at an advanced stage by the use of chemicals. The injection of chemicals like chloroform, or ethyl acetate, or petrol + kerosene oil mixture (1:1 ratio) or carbon disulphide + paradichlorobenzene mixture or petrol + kerosene oil + naphthalene mixture or EDB ampules (ethylene dibromide) each @ 5 ml/bore is recommended. These show 100% mortality of the larvae and do not produce any phytotoxic effect on the host plant (Sharma and Bhatia, 1993).

Cultivation of Resistant Clones

After assessing all aspects of damage, per cent infestation of poplar plantations vis-a-viz various clones of poplars by the larvae of *Apriona cinerea,* the authors recommend that clones like pd 92, pd 35/66, B.L. Costa 420, pd 45/51, pd 153, pd4/68, pd 4/64, pd 29, pd 2498, pd 74/53, ONDA, and D 69 should be frequently cultivated, as these varieties have shown minimum attack and maximum tolerance, thus suggesting minimum preference by *A. cinera* while G3, G48, and EG 65/27 clones have shown the maximum attack and minimum tolerance and thus its plantation should be reduced and restricted.

SUMMARY

Apriona cinerea Chevrolat (Coleoptera : Cerambycidae) has been recorded to be one of the most important insect pests of poplars in Jammu forests causing extensive damage to various plantations maintained by J&K State Forest Department. The present communication records a series of recommendations (which have been formulated after extensive field studies on the biology, lifecycle, control measure, ecology and preferences of the pest to various poplar clones in Jammu forests) to contain the damage caused by this wood boring beetle.

जम्मू वनों के वन पिप्पलों (पोपलरों) के गम्भीर तना छिद्रक नाशिकीट *एप्रायोना सिनेरिया* शेवरोलेट (कंचुकपक्षा : दीर्घशृंगक वंश) का प्रबन्ध और नियन्त्रण

बलदेव शर्मा व संजय भाटिया

सारांश

एप्रायोना सिनेरिया शेवरोलेट (कंचुकपक्षा : दीर्घशृंगक वंश) को जम्मू के वनों में लगे वन पिप्पलों के अधिक महत्वपूर्ण नाशिकीटों में से एक के रूप में अभिलिखित किया गया है जो जम्मू और कश्मीर राज्य के वन विभाग द्वारा लगाए हुए विविध रोपवनों को विस्तार से हानि पहुँचाता है। प्रस्तुत अभिपत्र में एक अभिस्ताव माला सूचित की गई है जिन्हें (जम्मू वनों में विभिन्न पोपलर कृन्तकों में लगने वाले नाशिकीटों की जैविकी, जीवनचक्र, नियन्त्रण उपाय, पारिस्थिकी और पसन्दगी का विस्तारपूर्वक अध्ययन करने के पश्चात तैयार किया गया है) ताकि काष्ठ छिद्रक भृंग द्वारा पहुंचाई जाने वाली हानि को रोका जा सके ।

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ARTIFICIAL RIPENING AND SEED MATURITY IN SILVER FIR *(ABIES PINDROW* SPACH)

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Introduction

Inadequate natural regeneration of *Abies pindrow* in North-West Himalayan States viz. Himachal Pradesh, Jammu & Kashmir and Uttar Pradesh because of low germination capacity, infrequent good seed years coupled with slow growth of its seedlings and other biotic interferences, necessitates collection of seed in large quantities to get nursery seedlings of this species for its artificial regeneration. Silver fir cones start opening by 15th of October. The seed collected on such date are mature enough to give higher germination percentage to those collected earlier. Silver fir normally sheds about 80% of its seed between 13th October to 24th November (Singh and Singh, 1984). It is therefore, difficult to collect seed in sufficient quantity off the trees, when its cones start opening. Thus harvesting of cones must be restored to accordingly.

Silen (1958) proposed the idea of employing artificial ripening of cones as a practical means of extending the period of seed collection. Wakeley (1954) also suggested that slightly immature cones of major southern pine species, collected one to two weeks earlier than the recommended time, may mature after harvest if stored properly. Singh (1989) was also of the same view after conducting studies on artificial ripening of cones in *Picea smithiana*.

Hence, the said study was undertaken to investigate the effect of artificial ripening of cones in silver fir.

Materials and Methods

The study was undertaken in stands of silver fir at two different elevations (2600 and 2850 m) in Kotgarh Forest Division of Himachal Pradesh. Within the selected stands, a plot of 60 x 60 m was laid out. Ten full crowned trees were selected randomly in each plot. Cone collection was carried out on 15th August, 1st September, 15th September, 1st October and 15th October, 1991. Five cones from each tree on each collection were stored at room temperature on open dry floor in laboratory. For each collection germination tests on fresh seed were also carried out.

The mean room temperature as recorded is given in Table 1.

The seeds were extracted from stored cones on 16th October hence, the storage period for cones collected on 15th August, 1st September, 15th September and 1st

Table 1

Mean room temperature during storage period

Period	Temperature °C	
	Maximum	Minimum
August, 1991	21.38	18.28
September, 1991	20.79	16.69
October, 1991	19.82	13.20
Average	20.66	16.05
S.D.	±0.78	±2.59

October worked out to be 8, 6, 4 and 2 weeks respectively. The cones collected on 15th October were not stored further as seed fall had already started at lower elevations with comparatively a little shedding on higher elevation. Seeds extracted from cones of sample trees of each collection were mixed and seed lots were subjected to germination tests. The seeds were sterilized by treating with 0.01% mercuric chloride solution for five minutes and were therefore, rinsed twice in distilled water before placing them on moist filter paper in petri-dishes kept in germination chamber at 20°C. Germination test for each collection was replicated four times. The germination value of the seed was calculated by following Djavanshir and Pourbeik (1976) :

GV = (Final DGS/N) x (Final cumulative germination %/10).

GV = Germination value
DGS = Daily germination speed
N = Number of counts.

Results and Discussions

The germination percentage and germination value to the stored seed and fresh seed as obtained are presented in Table 2.

The storage of cones at room temperature resulted in an improvement in germination percentage as well as in germination value (Table 2). The studies indicates that cones collected before 15th September are not mature enough but their storage have improved the seed germination. But the germination is comparatively lower than naturally matured cones. The cones collected on 15th September and 1st October from both the elevations when stored for four and tow weeks respectively, produced seeds with almost same germination percentage as that of 15th October collection at both the elevations, Thus, the silver fir cones can be collected at any time from second fortnight of September and can be stored successfully at room temperature (maximum 20.66°C ± 0.78 and minimum 16.05° C ± 2.59) for

Table 2

Germination percentage and germination value of fresh seed and stored seed.

Dates of collection	Storage period (weeks)	2600 m elevation				2850 m elevation			
		Fresh Seed		Stored Seed		Fresh Seed		Stored Seed	
		Germination (%)	Germination value	Germination (%)	Germination value	Germination (%)	Germination value	Germination (%)	Germination value
15th Aug., 1991	8	0.5	0.01	7.50	2.50	0.05	0.001	3.75	1.50
1st Sept., 1991	6	6.82	1.21	14.75	8.75	1.50	0.98	10.50	7.56
15th Sept., 1991	4	12.12	6.01	29.50	10.71	14.00	2.08	30.15	9.76
1st Oct., 1991	2	25.50	9.71	36.50	11.06	22.00	7.15	31.50	10.50
15th Oct., 1991	-	32.14	11.16	-	-	32.50	10.10	-	-

ripening, which would give more or less same germination as that of naturally matured cones.

Rediske (1961) conducted biochemical studies on maturation of Douglas fir seed and concluded that favourable seed storage conditions promote movement of nutrients in seed from the cone.

The same results were further confirmed by Rediske and Nicholson (1965) in Noble fir seed. Silen (1958) ripened the cones of *Pseudostsuga menziesii* artificially in wet peat moss five weeks prior to natural seed fall. Similar studies were carried out by Franklin (1965) in *Abies procera,* Oliver (1974) in *Abies concolor* and Zasoda (1973) in *Picea glauca*. Shearer (1977) also reported an increase in the seed yield and germination by delaying the seed extraction for *Larix occidentalis* cones by four to eight weeks. Silver fir cones collection hence, be restored to by 15th of September. However, the cones must be allowed to ripen artificially till its extraction in the second fortnight of October coinciding with its natural dehiscence.

SUMMARY

The paper presents the result of artificial ripening and seed maturity in silver fir (*Abies pindrow* Spach).

रजत तालीशपत्र (*एबीज पिंडो* स्पाश) का कृत्रिम पश्चपक्वन और बीज की प्रौढ़ता

ओमबीर सिंह, जे०एस० लल्हल व भगवती प्रसाद

सारांश

इस अभिपत्र में रजत तालीशपत्र (*एबीज पिंड्रो* स्पाश) के कृत्रिम पश्चपक्वन और बीजों में प्रौढ़ता लाने के प्रयत्नों के परिणामों को प्रस्तुत किया गया है।

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DIGITAL MAPPING OF FOREST FIRE IN GARHWAL HIMALAYA USING INDIAN REMOTE SENSING SATELLITE

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Introduction

Occurrence of forest fire is a common phenomenon in the tropics. They not only interrupt the plant growth but also disturb the ecosystem. Forest fires in India are primarily man-made and have become the cause of significant damage to the forest ecosystem. Along with extension of settlements and agricultural land, rapid urbanization and overgrazing, forest fires have caused tremendous reduction of forest cover during the past decades (Tiwari *et al.*, 1989). In view of magnitude of damage caused to the forest ecosystem along with revenue, it is essential to evolve a strategy based on the development of methodology for detecting the areas under forest fire along with other physical and biological parameters involved so that damage caused by fire could be minimized. Timely information on the location can help in preventing spread of forest fires as well as the planning and management of forests against forest fire. Ground based studies are quite tedious and time consuming for reliable estimation of fire damaged forest areas mainly due to inaccessible terrain. Satellite remote sensing techniques have been found to offer great potential in the field. In the past, attempts have been made in India to visually interpret satellite images to map forest fire affected areas (Khan *et al.*, 1992; Ayangar and Verma, 1992).

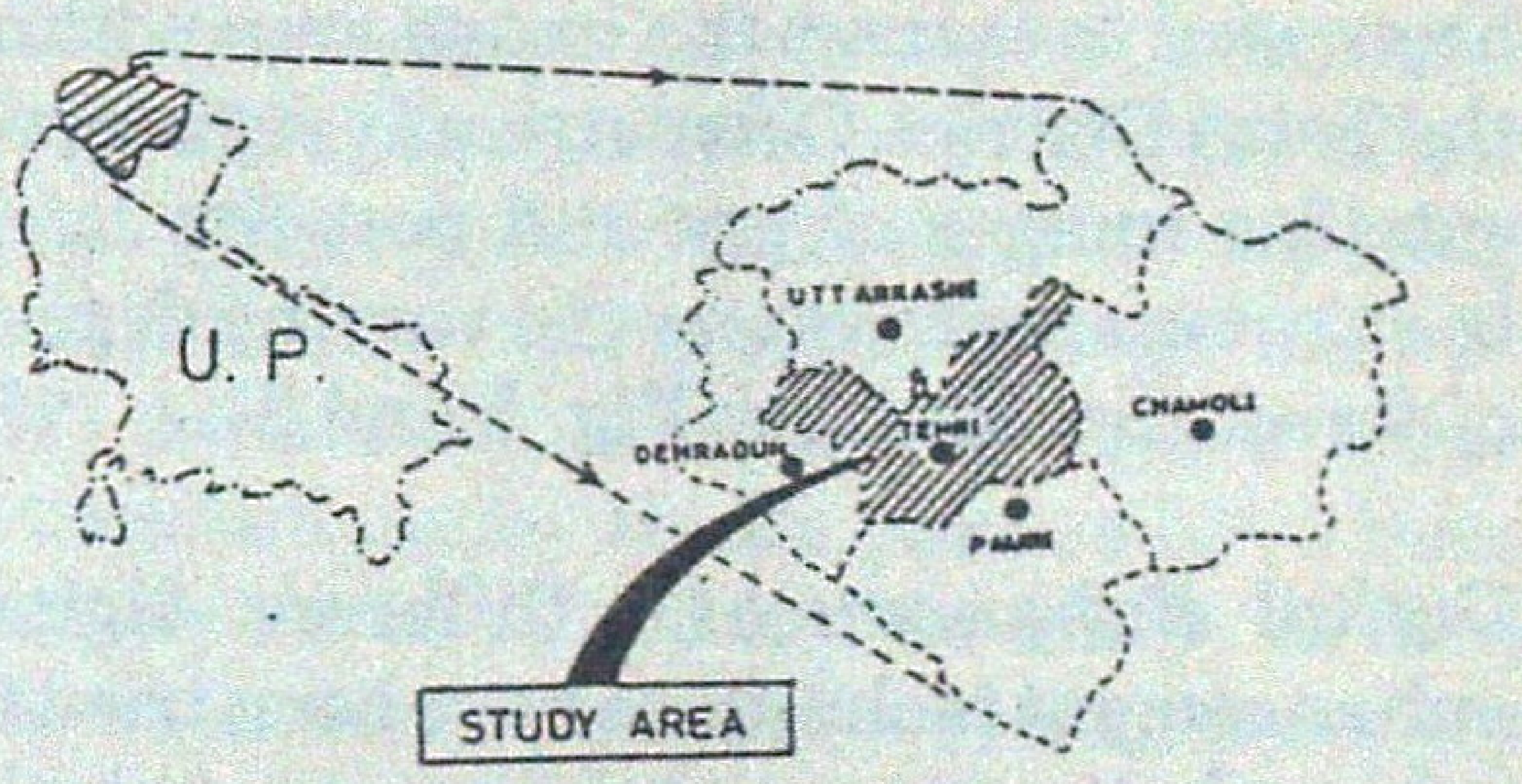
The forest fires in Central Himalayan region (Garhwal and Kumaon) occur between April to June annually when the climate is hot and dry. Usually the south facing slopes are prone to fire due to direct sun insolation and inflammable litters at the forest floor. It has been a common occurrence in pine and deciduous forests. During recent years satellite remote sensing techniques have greatly been helpful in mapping land cover and vegetation types (Anon., 1983; Anon., 1987). Their use in assessing forest fire are limited. Few studies are reported using visual interpretation techniques (Kimothi and Jadhav, 1995). However, the results of visual interpretation have been termed subjective. During 1995 the fire was extensive and severe not only within the pine forest but also in other forest areas due to prolong dry spell and high temperature. The mean maximum and mean minimum temperature during the months April to June (fire season) of the said year has been recorded near the study area as 35.1^0 and 17.1^0C. This temperature range has been the highest one in comparison to the temperature of the past 3 years. Similarly the total rain fall during the period of fire season has been recorded as 82.2 mm which is very less in quantity in comparison to total rain fall of 311.1 mm and 280.0 mm for the years 1993 and 1994 respectively. The extensive fire which ravaged extensive forest area during

Summer of 1995 in the Western and Central Himalaya drew wide attention of the forest managers and environmentalists. The present study attempts to provide estimates about forest fire damaged areas using digital satellite remote sensing data in Tehri district of Garhwal Himalaya.

Study Area

The District Tehri (Fig. 1) falls between the geo-coordinates 30^{0} 00' to 31^{0} 00' N and 77^{0} 50' to 79^{0} 10' and represents 4421.26 km^{2} or 8.65% out of the total area of Central Himalaya. The district is characterized by hilly and mountainous terrain supporting varied forest types and composition controlled by altitude, landuse/land cover types along with perpetual snow cover on the mountain peaks. The area under forest cover represents 56.14% out of its total geographical area. Pine is the dominant forest type followed by oak, oak mixed and deciduous. Pine is most susceptible to fire almost every year particularly near habitation/agricultural patches. The overall climate of the entire area varies from tropical to temperate depending upon the altitudinal range of 600 m to 5000 m. The mean minimum and mean maximum temperature recorded at the vicinity of this area as 9.97^{0}C and 17.23^{0}C and the mean annual precipitation as 1008 mm.

Fig. 1



Location Map - Tehri Garhwal

Data used

The data used giving details of sensors, hardware and maps is given in Table 1.

Methodology

The methodology consisted of the study and analysis of remote sensing data of pre-fire and post-fire period (1993 and 1995). Digital analysis technique of IRS-1B, LISS-II multi-spectral remote sensing data (Fig. 2) has been used to ascertain the intensity of burning based on the ground truth information. The supervised per pixel classification and digital enhancement approach have been used to identify the forest fire affected areas. The digital geometric correction of satellite images have been done using 1:250,000 scale Survey of India topographical sheets. The district

Table 1

Satellite	Sensor	Type of Data	Path	Row	Period
Remote Sensing Data :					
IRS-1B	LISS-I	CCT	28,29	46,46	27-5-95
IRS-1B	LISS-II	CCT	28,29	46,46	12-11-93
Computer System :					
	Hardware	- IBM RS/6000			
	Software	- EASI/PACE			

Survey of India Topographical maps on 1 : 250,000 scale boundary has been digitized and mask has been used to extract the image area within the Tehri District. Geometrically registered satellite images of pre and post-fire have been compared to assess the varying degree of forest fire damage (Fig. 2 and 3).

Digital Enhancement : Different digital enhancement techniques have been tried to achieve better interpretability and contrast between the features. Digitally enhanced images have also facilitated to choose correct training sets, exact demarcation and in assessment of classification accuracy. Out of the various enhancement techniques used in the present study, the best enhancement technique to delineate forest fire affected areas is the colour composite image of IR, NDVI, and intensity under equal stretching. This has differentiated the burnt, smoke plumes and the areas under the stage of active burning along with other landuse/ land cover classes (Fig. 4).

Digital Classification : Supervised classification technique using maximum likelihood classifier was used to identify forest fire affected areas. The training sets

Fig. 2

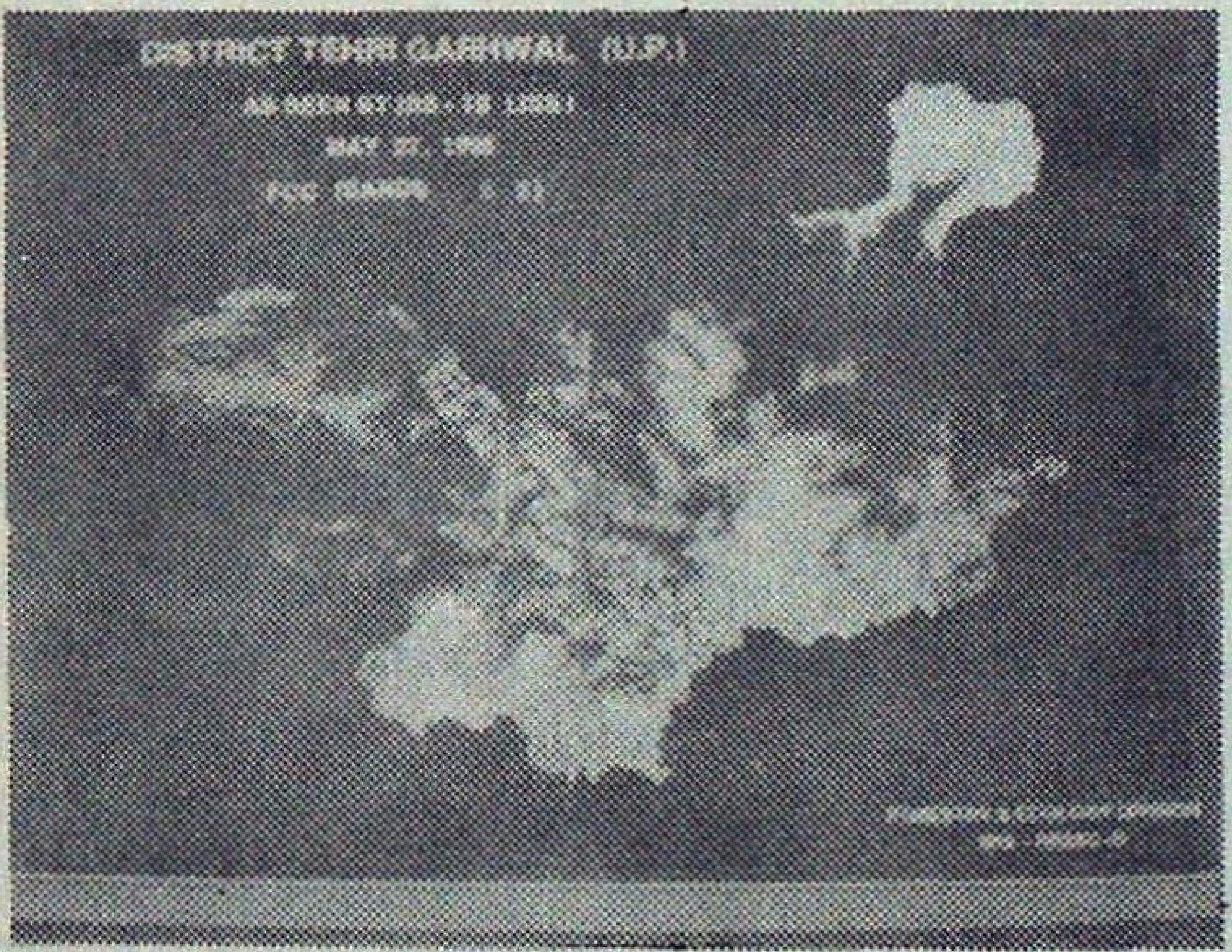

DISTRICT TEHRI GARHWAL (U.P.)

Fig. 3

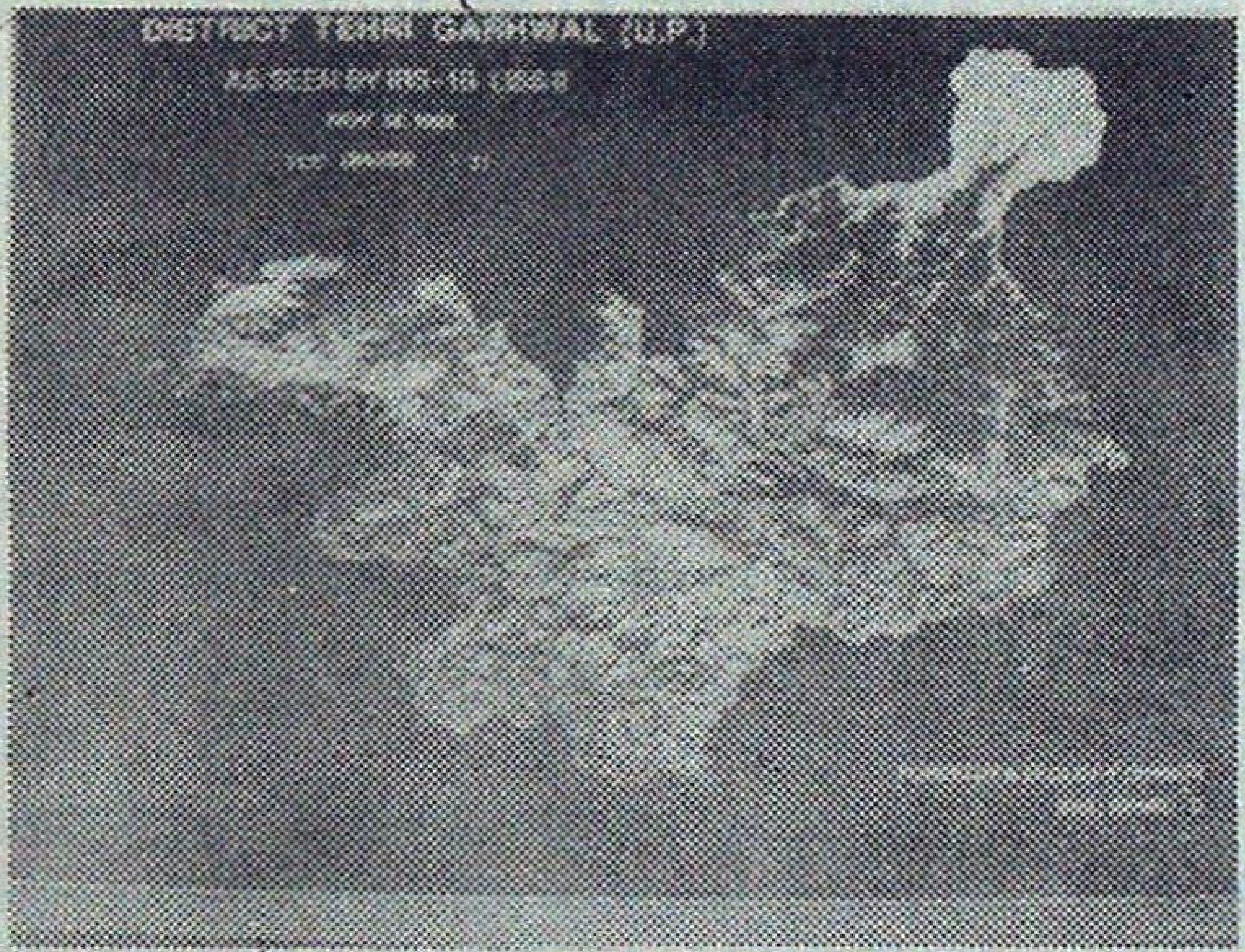

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Fig. 4

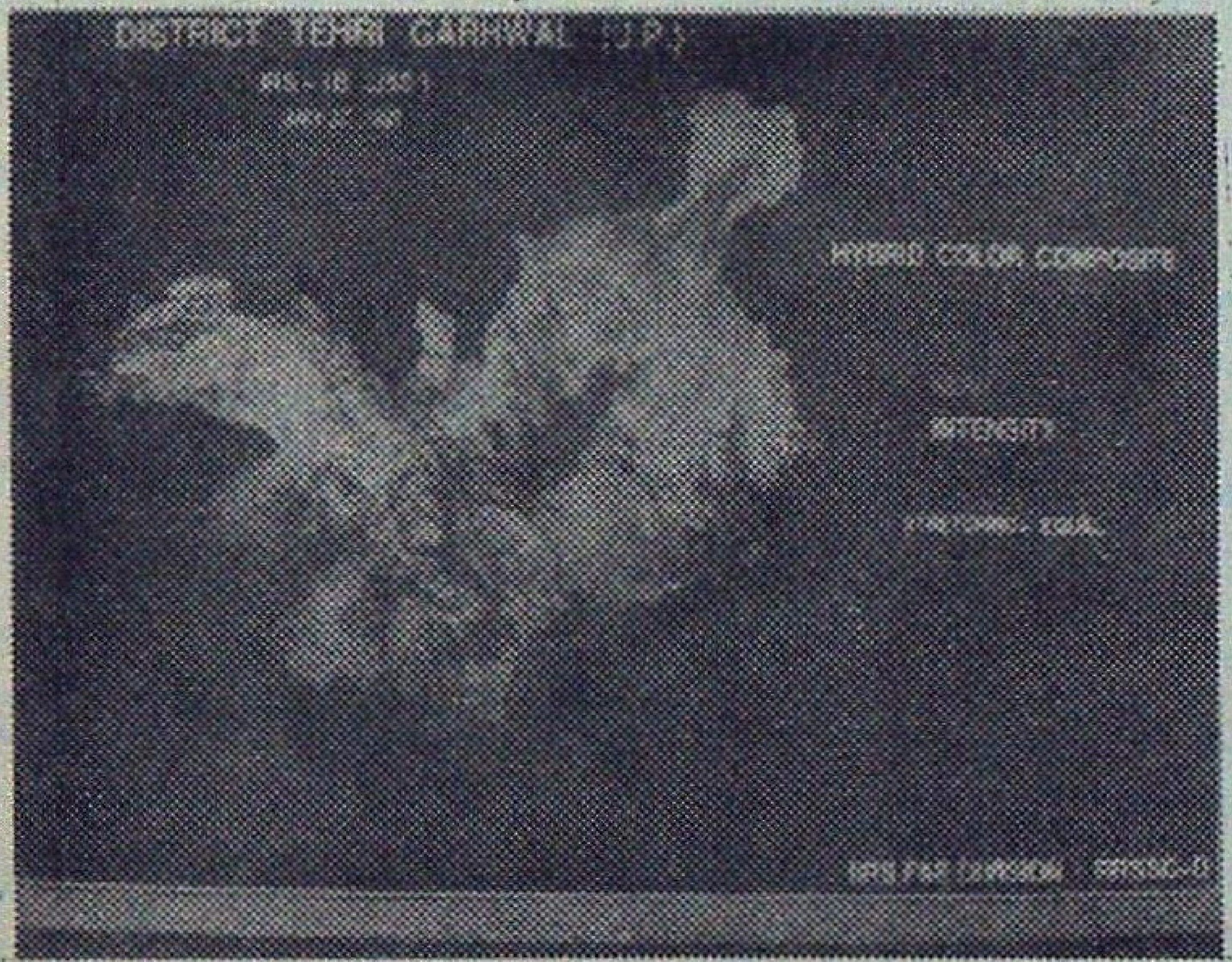
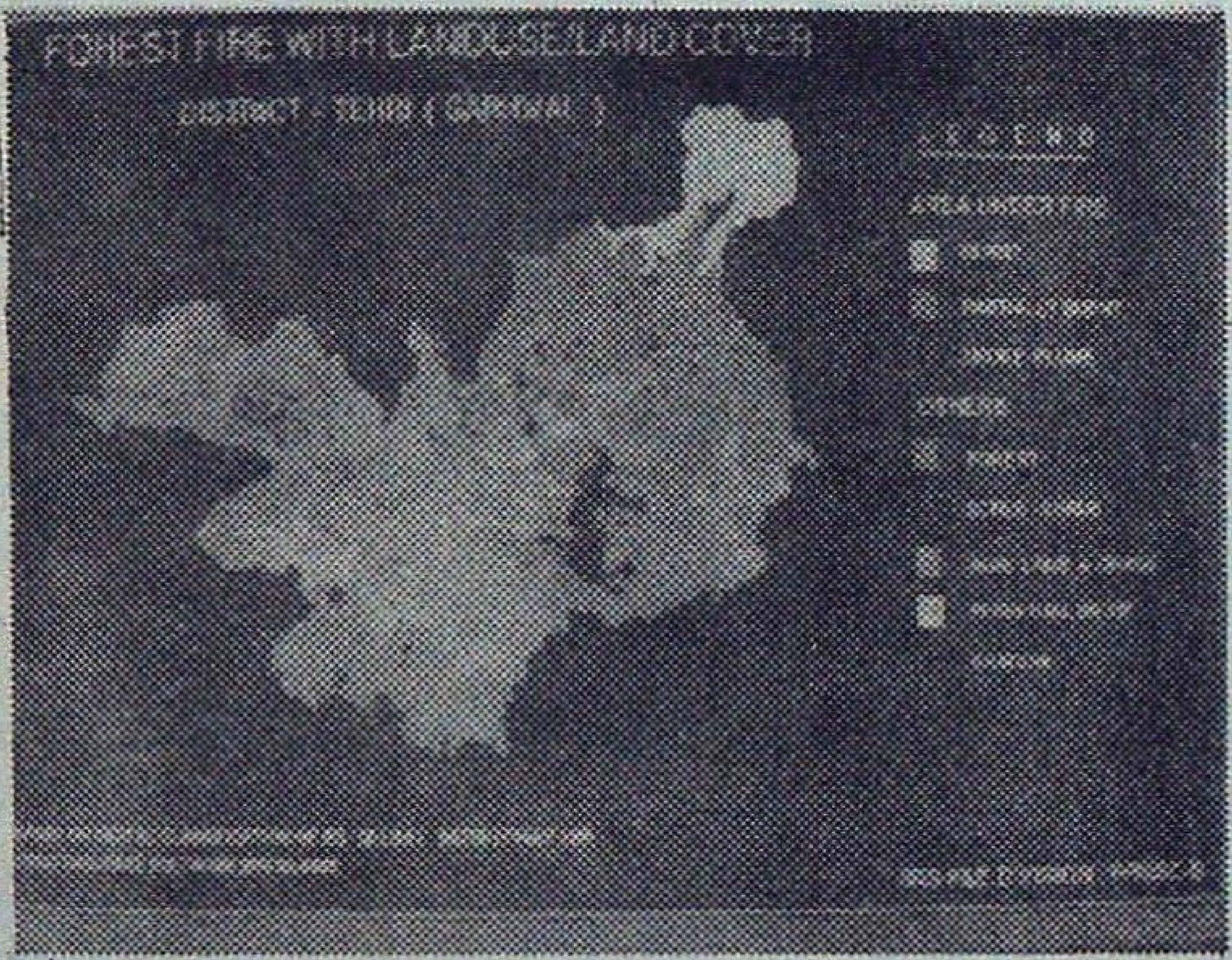

DISTRICT TEHRI GARHWAL (U.P.)
HYBRID COLOR COMPOSITE
INTENSITY

Fig. 5


FOREST FIRE WITH LANDUSE/LAND COVER
DISTRICT - TEHRI (GARHWAL)
LEGEND

were assigned based on the information collected from fire burnt areas and the surrounding features/cover types. The classes which have been identified and delineated are burnt, partially burnt, smoke plumes, forest, scrub/shrub, agricultural and grassland, perpetual snow cover and the areas under shadow. The accuracy of the various categories has been ascertained using confusion matrix of training set classification.

Results and Discussions

The mapping of areas affected under forest fire (Fig. 5) has been done using digital classification technique of remotely sensed data obtained from IRS-1B, LISS-I and LISS-II data. The total area affected under forest fire has been estimated as 910.01 km^2 or 20.58% of total geographical area. This area includes forest burnt area as 168.88 km^2 or 3.82% of total geographical area, partially burnt forest area (area under active fire) as 473.69 km^2 or 10.71% of the total geographical area and the partially burnt fallow land/grassland/scrub land as 267.44 km^2 or 6.05%. The forest areas identified under smoke plumes have been estimated as 130.96 km^2 or 2.96% of total forest area (Table 2). The overall accuracy of classification and subsequent estimation of these figures has been assessed as 88%.

An attempt has also been made to map forest fire in U.P. Himalaya using visual interpretation technique of IRS-1B LISS-I false colour composite image on 1:250,000 scale (Kimothi and Jadhav, 1995). The study showed different intensity of burning, fire migration pattern and speed in different locality and cover types. The burnt and partially burnt forest areas have been estimated as 6.35 and 9.11% respectively. The study seems to have two limitations viz., visual interpretation is subjective and

Table 2

Estimation of area affected by forest fire in Tehri District using Indian remote sensing satellite data
(situation as on 27th May, 1995)

Cover types	Total geographical area	(%)	Area under fire (km^2)						Area under smoke plumes	
			Burnt	(%)	Partially burnt	(%)	Total	(%)	Area	%
Forest (Canopy cover>10%)	2462.00	56.14	168.88	3.82	473.69	10.72	642.57	14.53	130.96	2.96
Agriculture, fallow, grasslands and scrub/shrub	1603.44	36.27	—	—	267.44	6.05	267.44	6.05	—	—
Snow	282.62	6.39	—	—	—	—	—	—	—	—
Shadow	14.35	0.32	—	—	—	—	—	—	—	—
Unclassified	38.85	0.88	—	—	—	—	—	—	—	—
Total	4421.26	100.00	168.88	3.82	741.13	16.77	910.01	20.58	130.96	2.96

mapping on 1:250,000 scale has considerable generalisation in such events. Consequently the estimates made in the present study as 3.82 and 10.71% for the same categories are more reliable since it is made on the reflection characteristic of the forest fire events. In addition, the digital approach has per pixel classification enabling higher accuracy in area estimation. Similar opinions have been expressed in other remote sensing studies in vegetation classification (Roy *et al.*, 1988).

Forest fires are of common occurrence in the tropics of Indian sub-continent. The high frequency and intensity cause extensive damage to the flora, fauna and ecology. It has always been a challenge to map and follow the spread of the forest fire to prevent damage to the forest resources. Satellite remote sensing data with its synoptic and repetitive coverage holds great promise to provide timely information. Identification of forest fire areas, their subsequent monitoring and consideration of other fire causing factors will lead mapping of forest fire risk areas. Such maps can be of immense use to forest managers.

In recent times of satellite borne NOAA AVHRR images have successfully been used for monitoring and detection of forest fires in the tropics (Muirhead and Crackvell, 1985; Matson *et al.*, 1987). The hot spots detected using the thermal infrared channel (3.55-3.93 micro m) of NOAA AVHRR sensor have been indirectly applied in identifying fires due to shifting cultivation. Forest fire maps along vegetation maps derived using vegetation indices are used to monitor major fires. However, NOAA-AVHRR data has wide swath and coarse resolution (1.1 km). The results of present study are significant in the context that forest fire damages has been detected using digital data of narrow swath satellite. The present study, however could not make any assessment of the area under the smoke plumes. This is an inherent limitation of optical remote sensing. However, this could be overcome by studying subsequent satellite passes. In the present study such an area was only 2.9% therefore not attempted. Finally, it is evident from the study that satellite remote sensing data can be reliably used to identify forest fire affected areas and this information can be obvious input to plan forest fire management strategy.

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SUMMARY

Forest fires have caused significant damage to the forest ecosystem. The devastating fire which ravaged extensive forest area during the Summer of 1995 in the Western and Central Himalaya drew wide attention of the forest managers and environmentalists. It is essential to evolve a strategy to minimize the damage caused by fire. IRS-1B LISS-II multi-spectral remote sensing data of pre-fire and post-fire period (1993 and 1995) pertaining to district Tehri (U.P) have digitally been analysed. The supervised classification and digital enhancement approach have been used. The geometrically registered images have been compared to assess the varying degree of forest fire damage. The total area affected under forest fire has been estimated as 20.58% of the total geographical area. The forest fire affected areas are classified as burnt forest, partially burnt forest and partially burnt fallow/grassland/scrub land. A real extent of these are: 3.82, 10.72 and 6.05% respectively. The forest areas identified under smoke plumes have been estimated as 2.96% of total geographical area.

गढ़वाल के हिमालय प्रदेशीय वनों में लगने वाली आग का भारतीय दूर संवेदन उपग्रह उपयोग में लाकर आंकिक मानचित्रण

डी०एन० पंत, के०के० दास व पी०एस० राय

सारांश

वनों में लगने वाली आग ने वनों की परिस्थिति-संहति को काफी हानि पहुँचाई है । 1995 की गर्मियों में पश्चिमी और मध्य हिमालयी प्रदेश में विस्तृत वन क्षेत्रों को जलाकर नष्ट करने वाली विनाशकारी आग ने वनों के प्रबन्धकों और पर्यावरणविदों का ध्यान आकर्षित किया । आग से होने वाली हानि को न्यूनतम रखने के लिए कोई-न-कोई रणनीति विकसित करना एकदम अनिवार्य है । आग लगने से पहले और आग लगने के बाद की अवधि (1993 व 1995) के आईआरएस-1 बी एलआईएसएस - 11 बहुप्रयोजन दूर संवेदन आंकड़ों का, जिनका संबन्ध टिहरी जिले (उ०प्र०) से है, आंकिक विश्लेषण किया गया है । अधीक्षित वर्गीकरण और आंकिक वृद्धि दृष्टि को इसके लिए उपयोग में लाया गया । रेखागणितीय बने रूपों की तुलना आग से वनों को पहुँची हानि कि विभिन्न मात्राओं का अनुमान लगाने के लिए ही की गई हैं । आग से प्रभावित हुए कुल क्षेत्र संपूर्ण भूक्षेत्र का 20.58% होना अनुमानित किया गया है । आग से प्रभावित हुए क्षेत्रों का वर्गीकरण जला वन, अंशतः जला वन, और अंशतः जला परती/घास क्षेत्र और/अनुक्षुपवन किया गया है । क्षेत्र विचार से क्षेत्र क्रमशः 3.82, 10.72 और 6.05% रहे हैं । धुएँ की शिखा से प्रभावित हुए क्षेत्र को कुल भूक्षेत्र का 2.96% होना अनुमानित किया गया है ।

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EFFECT OF LOPPING INTENSITIES ON GROWTH AND BIOMASS PRODUCTION OF *BAUHINIA PURPUREA* L. IN NORTH-WEST HIMALAYA LOW HILL REGION

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Introduction

Bauhinia purpurea L. is a moderate sized evergreen multi-purpose tree (MPT) grown on terrace risers or in combination with agricultural crops in the Himalayan region (Chaturvedi, 1957). The leaves of the tree are used as green fodder (Anon,1988; Debroy *et al.*, 1980, Gupta, 1993; Negi, 1977; Singh, 1983) and the branches are used for fuel purpose. Therefore, the tree is extensively lopped in the hill region.

However, information on the scientific lopping management practice of the tree i.e. intensity and periodicity of lopping, is very limited. This information is necessary for better growth and higher production of fuel, fodder etc., on sustained basis. Some studies of few MPTs have been conducted (Bhimaya *et al.*, 1964; Debroy *et al.*, 1982; Ganguli *et al.*, 1964; Sharma *et al.*, 1991; Srivastava, 1978). Roy and Debroy, 1983 studied two lopping intensities at an interval of six months on *Bauhinia purpurea* at Bundelkhand region. Rawat (1993) has done the economic analysis of tree lopping on *Acacia nilotica* in Haryana.

The present study was undertaken to compare the effect of two lopping intensities (i.e., 50 and 75 per cent) with no lopping (control) on growth and production from *Bauhinia purpurea*. The relationship between leaf yield and growth parameters (i.e., height, diameter at breast height and crown diameter) was developed separately at 50 and 75 per cent lopping intensities using regression models.

Materials and Methods

The study was conducted at the Research Station at Selakui about 16 km North-West of Dehra Dun of the Central Soil and Water Conservation Research and Training Institute ($30^0 21'$N latitude, $70^0 52'$E longitude and at an altitude of 517 m above m.s.l.).

The genesis of the soil is of very deep recent alluvium on riverbed. Layers with various thickness having different percentage of coarse fragment (boulders and gravel - 20 to 80 per cent) are visible throughout the profile depth. The texture of the soil varies from loamy sand to sandy loam (Satyanarayana and Dhir, 1959). The average annual rainfall is 1672 mm. The maximum temperature reaches upto 45^0 during May-June while the minimum has been recorded as low as 0^0C during January.

Bauhinia purpurea seedlings of

uniform age and size were transplanted at a distance of 4 m in a single row on a field bund during 1975. Two lopping intensities (50 and 75 per cent) were studied for eight years 1979 to 1986 and with no lopping treatment as control. The yield and growth data recorded in December 1979 was excluded from the present study for having a uniform pattern. Six trees in each treatment for 50 and 75 per cent lopping intensities and four trees for no lopping (control) were selected at random. Growth parameters viz. height, DBH and crown diameter were recorded during the month of December for individual trees under each treatment before imposing lopping treatment each year. Weight of fresh leaves and woody branches and twigs as per lopping intensity treatment were also recorded for the individual trees.

The two regression models tried are as under :

(i) $Y_1 = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_1^2 + b_5X^2_2 + b_6X_3^2 + b_{10}T$

(ii) $Y_1 = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_1^2 + b_5X_2^2 + b_6X_3^2 + b_7X_1X_2 + b_8X_1X_3 + b_9X_2X_3 + b_{10}T$

Where,
Y_1 = Fresh leaf yield (kg/tree)
X_1 = Height (cm/tree)
X_2 = D.B.H. (cm/tree)
X_3 = Crown diameter (cm/tree)
T = Plant age (years)

b_0 is constant and b_i (for all values of i) is the partial regression coefficient of the respective variable.

Step down regression analytical procedure was adopted and the standard error of respective partial regression coefficient and coefficient of determination (R^2) was also worked out (Draper and Smith, 1981). On the basis of R^2 the most suitable prediction equations were selected for the prediction of leaf yield of *Bauhinia purpurea* at different intensities of lopping.

Results and Discussions

The average fresh leaf yield (kg/tree), the wood (branches and twigs) yield (kg/tree), the height, the D.B.H. and the crown diameter of *Bauhinia purpurea* are presented in Table 1 for different years for all the three treatments (i.e., 50 and 75 per cent lopping intensity and no lopping (control). From the table the following conclusions were drawn.

(1) 75 per cent lopping intensity of *Bauhinia purpurea* gave higher leaf and wood yields in the first four years and thereafter 50 per cent lopping intensities gave more yields of leaf and wood. The yields were reduced drastically afterwards.

(2) Seven years (1980-86) average yield of fresh leaf was 4.87 kg/tree ranged from 2.17 kg to 8.77 kg/tree in different years under 50 per cent lopping intensity. The corresponding values were 4.34 kg/tree and ranged from 1.60 to 6.58 kg/tree under 75 per cent lopping intensity. Roy and Debroy (1983) recorded average annual production of green leaf fodder from 19.8 - 21.4 qts (dry 7.94 - 8.58 qts) per row km and dry wood 17.58 to 21.72 qts per row per km depending on the extent of lopping at an interval of six months.

(3) Seven years (1980-86) average yield of fresh wood (branches and twigs) was 6.63 kg/tree ranged from 4.06 kg to 10.30 kg/tree in different years under 50 per cent lopping intensity. The corresponding values were 7.51 kg/tree and ranged from 2.02 kg to

15.43 kg/tree under 75 per cent lopping intensity.

Paired 't' test was applied to test the significance difference between height, DBH and crown diameter in three treatments (i.e. 50 and 75 per cent lopping of trees and no lopping) and results so obtained showed the following.

(4) The height growth of 50 and 75 per cent lopping of trees did not differ significantly among themselves but these two lopping treatments differ significantly from control (no lopping). Height growth of 50 and 75 per cent lopping of trees were for superior than no lopping treatment. It may be inferred that the managed lopping of trees do not adversely effect the height growth of trees (Bhimaya *et al.*, 1964).

(5) The DBH growth of 50 per cent lopping of trees differ significantly from 75 per cent lopping of trees and no lopping treatments. However, the DBH growth of 75 per cent lopping of trees and no lopping treatment do not differ significantly. The DBH growth of 50 per cent lopping of trees was far superior than other two treatments.

(6) The crown diameter of 50 per cent lopping of trees was far superior than 75 per cent lopping of trees and no lopping treatment. But crown diameter of 50 per cent lopping of trees do not differ significantly from 75 per cent lopping of trees but differ significantly from no lopping.

Step-down regression analysis of both models for leaf yield at 50 and 75 per cent lopping intensities with coefficient of determination (R^2) and the standard error of the respective partial regression coefficients are presented in Table 2. On the basis of R^2, it is concluded that :

(i) Model II is far superior than Model I.

(ii) The fitted Model II at 50% lopping intensities for leaf yield is far superior as compared to 75% lopping intensities.

On the basis of significant R^2, significant partial regression coefficient and minimum standard deviation of the estimated yields of the leaf at both lopping intensities for Model II, the following regression models were selected separately.

50 per cent lopping intensity :

$$\begin{aligned} Y_1 = {} & \underset{(8.26)}{-0.15} - \underset{(2.451)}{5.073^{*}X_1} + \underset{(2.952)}{10.537^{**}X_3} \\ & + \underset{(0.561)}{1.707^{*}X_1^{2}} + \underset{(0.384)}{0.474\,X_3^{2}} - \underset{(0.158)}{0.359^{*}X_1X_2} \\ & \underset{(0.836)}{-3.009^{*}X_1X_3} + \underset{(0.222)}{0.579^{*}X_2X_3} \underset{(0.372)}{-1.013^{*}T} \end{aligned}$$

.... ($R^2 = 0.5349^{**}$)

75 per cent lopping intesity :

$$\begin{aligned} Y_1 = {} & \underset{(4.35)}{6.53} + \underset{(0.484)}{1.123^{*}X_2} + \underset{(1.005)}{3.397^{**}X_3} \\ & \underset{(0.015)}{-0.016X_2^{2}} \underset{(0.129)}{-0.310^{*}X_1X_3} \underset{(0.497)}{-0.757T} \end{aligned}$$

........................($R^2 = 0.5155^{**}$)

Conclusion

The growth parameters (viz. height, DBH and crown diameter) of two lopping intensities (50 and 75 per cent) were statistically at par with no lopping (control). Hence, it may be concluded that controlled lopping between 50 to 75 per cent intensity once in a year do not adversely effect on the growth of *Bauhinia purpurea* tree.

The average yield of fresh leaf were

Table 1

Yearly mean, range and coefficient of variation (%) in different lopping intensities of Leaf/wood yield, Height, D.B.H. and Crown dia.

Variable		1979	1980	1981	1982	1983	1984	1985	1986
1		2	3	4	5	6	7	8	9
T_1 - 50 per cent lopping									
Leaf yield	Mean	1.26	6.13	4.38	2.17	3.88	4.08	8.77	4.67
(kg/tree)	Range	0.25-2.10	2.9-13.80	1.20-10.10	1.10-5.20	2.50-5.30	1.80-5.80	5.20-11.70	3.00-6.50
Y_1	C.V.%	49.3	57.7	69.0	64.4	28.9	29.7	27.0	26.7
Wood yield	Mean	-	4.06	10.30	5.62	6.93	5.43	9.63	4.42
(kg/tree)	Range	-	2.28-9.15	2.00-36.20	1.00-15.4	4.40-10.8	4.00-8.40	4.00-14.50	2.00-7.50
Y_2	C.V.%	-	57.3	115.6	93.2	35.7	26.7	42.4	36.6
Height	Mean	4.23	5.08	5.78	5.89	6.81	8.08	8.87	9.40
(m)	Range	3.85-4.60	4.50-5.50	4.80-6.60	4.90-6.70	5.15-7.50	5.30-9.25	6.00-10.50	7.00-10.50
X_1	C.V.%	6.8	6.8	9.9	9.5	11.4	16.1	17.1	12.7
D.B.H	Mean	6.10	6.95	8.33	8.67	12.95	17.68	20.42	21.37
(cm)	Range	4.50-7.80	5.30-8.60	5.60-11.10	6.50-11.9	8.60-15.4	9.40-22.30	14.50-24.20	15.70-25.00
X_2	C.V.%	16.6	14.8	25.9	19.1	17.4	23.0	14.5	13.4
Crown	Mean	2.69	4.08	4.17	4.30	4.25	5.98	6.90	7.04
Dia (m)	Range	2.18-3.30	3.30-5.35	3.55-5.80	3.50-5.90	3.50-5.50	4.25-7.20	5.75-8.50	6.30-8.05
X_3	C.V.%	17.6	17.1	19.6	18.6	15.3	17.5	13.7	10.1
T_2 - 75 per cent lopping									
Leaf yield	Mean	1.77	6.58	5.25	2.55	5.08	3.39	5.90	1.60
(kg/tree)	Range	0.62-3.35	1.23-12.29	2.30-11.60	1.70-4.50	2.60-10.6	1.00-9.85	0.50-18.50	0.50-3.00
Y_1	C.V.%	49.2	57.2	59.1	36.3	51.7	99.0	109.0	60.6
Wood yield	Mean		4.82	15.43	8.85	9.42	3.23	8.78	2.02
(kg/tree)	Range		0.63-9.00	2.30-44.50	1.50-23.5	3.90-19.5	1.30-6.00	1.20-18.00	0.50-3.50
Y_2	C.V.%		61.0	94.0	96.0	53.5	51.3	72.7	47.0
Height	Mean	3.62	4.82	5.45	5.50	6.38	8.37	8.98	9.38
(m)	Range	3.20-3.95	4.20-5.50	5.00-6.00	5.15-6.20	5.40-7.25	7.35-9.50	8.00-9.90	8.00-10.50
X_1	C.V.%	7.5	10.9	6.6	6.7	10.2	10.5	7.6	10.2
D.B.H.	Mean	5.82	7.08	8.57	4.47	12.63	15.98	19.48	20.06
(cm)	Range	3.90-7.90	5.00-8.40	4.90-11.10	6.00-8.90	9.80-16.0	14.40-18.0	15.70-26.20	17.40-25.60
X_2	C.V.%	26.0	16.9	25.0	13.0	17.6	8.1	18.6	14.2
Crown	Mean	2.92	4.68	4.60	4.72	5.04	5.18	6.35	5.93
Dia (m)	Range	1.36-4.13	3.45-7.75	3.20-7.35	3.25-7.40	3.32-8.30	4.10-6.15	4.50-7.75	4.25-7.45
X_3	C.V.%	28.8	30.7	28.6	27.5	31.5	15.4	16.6	17.8

Contd...

1		2	3	4	5	6	7	8	9
				T_3 - No lopping (Control)					
Height	Mean	3.78	4.35	5.30	5.00	6.27	6.87	8.00	9.33
(m)	Range	3.30-4.05	3.80-5.25	5.00-5.60	3.80-5.60	5.80-6.75	6.00-7.35	7.00-8.50	8.50-10.25
X_1	C.V.%	7.9	12.8	4.8	14.1	6.2	8.9	8.8	7.7
D.B.H.	Mean	4.55	6.38	7.75	8.15	13.60	16.93	18.77	20.10
(cm)	Range	3.4-5.6	4.20-7.50	6.20-8.90	6.70-9.20	12.5-14.9	15.30-20.0	17.50-21.10	18.50-23.00
X_2	C.V.%	17.2	20.6	12.7	11.1	7.3	12.8	8.8	10.2
Crown	Mean	2.97	4.57	4.59	4.69	5.77	6.98	8.75	10.03
Dia (m)	Range	2.41-3.48	3.50-5.25	3.30-6.40	3.40-6.50	4.55-7.00	5.75-8.70	6.50-10.25	6.15-15.10
X_3	C.V.%	15.8	14.5	24.9	24.3	17.3	17.9	18.5	37.4

Table 2

Coefficients of regression constants, their standard errors and multiple correlation coefficient for leaf yields (Model I and II) in different lopping intensities

b_0	b_1	b_2	b_3	b_4	b_5	b_6	b_7	b_8	b_9	b_{10}	R^2
1	2	3	4	5	6	7	8	9	10	11	12
Model I						50 per cent lopping					
-6.71	-0.109	-0.129	5.610*	-0.009	0.019	-0.365				-0.386	0.3549*
(11.07)	(3.587)	(0.736)	(2.378)	(0.243)	(0.026)	(0.207)				(0.378)	
-6.98		-0.147	5.603*	-1.107	0.020	-0.365				-0.383	0.3549*
(6.45)		(0.453)	(2.332)	(0.054)	(0.017)	(0203)				(0.363)	
-7.55			5.528*	-0.105	0.015	-0.359				-0.413	0.3530**
(6.13)			(2.292)	(0.053)	(0.009)	(0.200)				(0.347)	
-9.01			5.256*	-0.095	0.009	-0.359					0.3275**
(6.04)			(2.293)	(0.052)	(0.008)	(0.201)					
-10.07			5.214*	-0.039		-0.346					0.3431**
(6.00)			(2.303)	(0.020)		(0.202)					
-0.08			1.313**	-0.036							0.2491**
(1.50)			(0.378)	(0.020)							
0.41			0.849**								0.1895**
(1.51)			(0.278)								

Contd...

1	2	3	4	5	6	7	8	9	10	11	12
						75 per cent lopping					
-2.29	0.637	1.274	0.534	-0.132	-0.024	0.065				-0.843	0.5038**
(13.94)	(3.522)	(0.630)	(3.748)	(0.216)	(0.019)	(0.332)				(0.567)	
-0.89	0.543	1.311*		-0.127	-0.025	0.112**				-0.824	0.5034**
(9.77)	(3.407)	(0.564)		(0.210)	(0.017)	(0.040)				((0.542)	
0.58		1.353**		-0.094*	-0.027	0.114**				-0.794	0.5030**
(3.08)		(0.491)		(0.043)	(0.015)	(0.036)				(0.502)	
-1.49		1.077*		-0.136**	-0.024	0.129**					0.4654**
(2.84)		(0.469)		(0.035)	(0.015)	(0.036)					
2.69		0.369*		-0.127**		0.119**					0.4234**
(1.27)		(0.183)		(0.035)		(0.036)					
Model II						50 per cent lopping					
14.31	-12.370	2.437	9.155**	0.126	0.514	-1.079	-0.622**	0.451	-1.106**	-1.06**	0.5628**
(14.75)	(6.771)	(1.922)	(3.113)	(0.996)	(0.090)	(0.386)	(0.540)	(0.881)	(0.240)	(0.394)	
-0.84	-4.757		10.233**	1.739**	0.030	0.771	-0.455	-2.910**	0.550*	-0.969*	0.5402**
(8.41)	(2.539)		(3.023)	(0.569)	(0.650)	(0.388)	(0.224)	(0.859)	(0.229)	(0.383)	
-0.15	-5.073*		10.537**	1.707*		0.474	-0.359*	-3.009*	0.579*	-0.013*	0.5349**
(8.26)	(2.451)		(2.952)	(0.561)		(0.384)	(0.158)	(0.836)	(0.222)	0.372)	
-3.99	-5.044*		12.034**	1.530**			-0.362*	-2.533**	0.589*	0.980*	0.5134**
(7.11)	(2.469)		(2.712)	(0.547)			(0.159)	(0.747)	(0.223)	(0.374)	
						75 per cent lopping					
-12.51	1.605	0.723	4.431	0.011	-0.021	-0.041	-0.019	-0.589	0.113	-0.698	0.5245**
(17.61)	(4.923)	(1.363)	(5.485)	(0.630)	(0.058)	(0.390)	(0.375)	(0.584)	(0.189)	(0.620)	
-12.75	1.671	0.708	4.409		-0.022	-0.039	-0.013	-0.587	0.112	-0.701	0.5244**
(16.96)	(2.983)	(1.034)	(5.239)		(0.038)	(0.376)	(0.145)	(0.554)	(0.175)	(0.571)	
-12.16	1.565	0.674	4.463		-0.025	-0.036		-0.605	0.115	-0.691	0.5243**
(16.05)	(2.687)	(0.939)	(5.117)		(0.023)	(0.368)		(0.504)	(0.167)	(0.551)	
-19.95	1.449	0.726	4.006		-0.025			-0.585	0.108	-0.683	0.5242**
(9.99)	(2.370)	(0.757)	(2.057)		(0.022)			(0.450)	(0.144)	(0.535)	
-5.63		1.068*	3.040**		-0.023			-0.322*	0.041	-0.684	0.5184**
(4.86)		(0.506)	(1.303)		(0.022)			(0.134)	(0.093)	(0.530)	
-6.53		1.123*	3.397**		-0.016			-0.310*		-0.757	0.5155**
(4.35)		(0.484)	(1.005)		(0.015)			(0.129)		(0.497)	
-4.66		0.645**	3.559**					-0.337*		-0.610	0.4975**
(4.03)		(0.221)	(0.997)					(0.128)		(0.481)	
-8.61		0.507**	4.343**					-0.433**			0.4737**
(2.57)		(0.194)	(0.789)					(0.103)			

* and ** indicate 5 and 1 per cent significance level. Figures in parenthesis are the SE of regression coefficients

4.87 kg/tree and 4.34 kg/tree under 50 and 75 per cent lopping intensity respectively. The average yield of fresh wood (branches and twigs) were 6.63 kg/tree and 7.51 kg/tree under 50 and 75 per cent lopping intensity respectively.

Production of fresh leaf can be estimated accurately through the developed models with the help of growth parameters. Because R^2 of these models were of high order.

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SUMMARY

The forage potential from *Bauhinia purpurea* tree has been fully appreciated in the hill region. Tree lopping for green fodder is resorted without information on scientific lopping management practice i.e. intensity and periodicity of lopping, which is required for optimum sustainable production without damaging the trees. Studies on *Bauhinia purpurea* planted on field boundary at Dehra Dun were conducted to compare the effect of two lopping intensities (i.e. 50 to 75 per cent) with no lopping on growth of trees and production of fodder on sustained basis. The studies clearly indicated that 50 to 75 per cent lopping of *Bauhinia purpurea* L. trees once in a year do not adversely affect the tree growth. The relationship between leaf yield with growth parameters were also developed.

उत्तर-पूर्वी हिमालय प्रदेश के निचली पहाड़ी क्षेत्र में *बौहीनिया पर्पूरिया* लि० की बढ़वार और जैवपुंज उत्पादन पर झंगान करने की चण्डताओं का प्रभाव

आर०के० गुप्त, एम०सी० अग्रवाल व निर्मल कुमार

सारांश

बौहीनिया पर्पूरिया वृक्ष की चारा संभावनाओं को पहाड़ी प्रदेशों में पूरी तरह से समझा गया है । हरे चारे के लिए वृक्ष का झंगान, उसकी झंगान करने की प्रबन्ध विधियों अर्थात् झंगान करने की चण्डता और उसकी अवधि पर कोई वैज्ञानिक जानकारी उपलब्ध हुए बिना ही किया जाता आ रहा है जो कि वृक्षों को हानि पहुँचाए बिना नैरन्तरिक आधार पर उनसे अधिकतम उत्पादन लेने के लिए आवश्यक होती है । देहरादून में खेतों की मेंढ़ों पर उगाए हुए *बौहीनिया पर्पूरिया* वृक्षों पर कुछ अध्ययन दो झंगान चण्डताओं (अर्थात् 5० और 75%) की तुलना कोई भी झंगान न करने के साथ, नैरन्तरिक आधार पर वृक्षों की वृद्धि और उनके व्यास उत्पादन पर प्रभाव की दृष्टि से करने के लिए किए गए । यह अध्ययन स्पष्टतः बताते हैं कि *बौहीनिया पर्पूरिया* ली० वृक्षों का 50 से 75% झंगान एक वर्ष में करना वृक्षों की वृद्धि पर कोई प्रतिकूल प्रभाव नहीं डालता । पत्तियों की प्राप्ति और वृद्धि परिमापों के दरम्यान संबन्ध भी विकसित किए गए हैं ।

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SPECIES SELECTION FOR HIGHER PRODUCTIVITY IN *AILANTHUS*

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Introduction

The genus *Ailanthus* is having 5 species of deciduous trees occurring in Southern Asia, Malaya, China and Australia of which 4 species occur in India including one introduced and naturalized. In India, *Ailanthus triphysa* (Dennst.) Alston is found in Western Ghats from Konkan through Karnataka to Travancore upto 1500 m elevation. It is one of the best Indian matchwood species used both for splints and boxes. It is used for plywood, catamarans, fishing floats, sword handles etc. The bark, gun, roots and leaves are used medicinally.

Due to its quick rate of growth, it is recommended as a plantation species which produce matchwood within a short rotation. Out of the total requirements, only ten per cent is met from the forests of Kerala and hence, demand is very high (Nair *et al.*, 1984). It fetches good price and ready market and hence, in Kerala it is grown in homesteads. It is also popularised under Social Forestry.

In Kerala, young plantation were raised by the Forest Department, but the performance is not that attractive, since two major pests, *Atteva fabriciella* and *Eligma narcissus* cause serious damage to young plants (Varma, 1986). Pure crops of *A. excelsa* Roxb. also are attacked by these pests in Tamil Nadu and Madhya Pradesh (Chatterjee *et al.*, 1969). Pest outbreaks were noticed more often in young plantations and nurseries; older plantations were generally free from damage but they were attacked during flowering and fruiting seasons which results in scarcity of seeds.

Repeated attacks of these pests cause complete defoliation and complete drying of terminal buds causing stunted growth and branching of plants leading to poor yield.

Chemical control of these pests is possible but the sudden outbreak and the high cost of chemicals make it impractical. The poor performance of the plantations necessitated the identification of an alternate species which can serve the same purpose. During plus tree selection of *A. triphysa*, it was noticed that a small plot of 0.4 ha area of *A. integrifolia* ssp. *calycina* (syn. *A. grandis*) raised at Kodanad of Malayattoor Forest Division was completely free from pest attack. This species was introduced by the Forest Department in 1963 from North-Eastern States. The species is well known for its quicker rate of growth, very straight cylindrical bole, less tapering and restricted crown, excellent natural pruning and apical dominance (Guhathakurta and Ghosh, 1972). Wood is used for match splints and box, box planking and newsprint grade of pulp and plywood.

Hence, work has been initiated to study the growth performance and its

Table 1

Survival per cent of A. integrifolia and A. triphysa.

Special	*A. integrifolia* ssp. *calycina*					*A. triphysa*				
Family	1	2	3	4	5	6	7	8	9	10
Survival	56.67	63.33	60.00	83.33	46.67	83.33	80.00	56.67	83.33	90.00
%			62%					78.66%		

susceptibility to insect pests compared to that of *A. triphysa* and the result is presented in this paper.

Materials and Methods

Seeds of 5 plus trees of *A. triphysa* were collected from Wynad and Nilambur Forest Divisions of Kerala and from 5 mother trees of *A. integrifolia* ssp. *calycina* grown at Kodanad. Nursery was raised at KFRI Camps, Peechi and seedlings were polypotted when they were 4 months old. During second year they were field planted at Nilambur in a randomized block design with 10 families (1-4 of *A. integrifolia* and 6-10 of *A. friphysa*) with 3 replications of 10 plants each. Observations were taken on the pest attack in the nursery and survival in the field. Growth measurements were taken in the nursery as well as in the field.

Statistical analysis of the data was carried out as suggested by Wright (1976). Mean Values of the families were compared using the procedure given in Calinski and Corsten (1985).

Results and Discussions

A. integrifolis ssp. *calycina* was found to be completely free from insect pests while, *A. triphysa* was attacked many times and controlled by insecticidal application.

Two years after field planting (at the age of 4 years) the survival rate was noted (Table 1) and it reveals that the survival was only 62 per cent in *A. intergrifolia* where as in *A. triphysa* it was 78.66. But family No. 4 of *A. integrifolia* shows good survival rate of 83.33 per cent.

The height measurements of 2 year and 3 year old plants and the basal girth measurements of 3 year plants were taken for which the analysis of variance was worked out (Table 2).

From the analysis it is evident that there is significant difference in mean height between families and between species, *A. integrifolia* to be the best. But the difference in girth between families and species is not significant. The components of variance due to block, family, interaction and error have been indicated as percentage (figures in parentheses) of the total variance. These figures indicate that the genetic variance for height was about 71 to 93 per cent but for girth, it was only 16.69.

When the mean values of the families were compared, the following pattern is obtained :

2 years height $\overline{\text{F8 F7 F9 F6}}$ $\underline{\text{F10 F3 F1 F2 F5 F4}}$

3 years height $\overline{\text{F7 F8 F6 F10 F9 F1}}$ $\underline{\text{F2 F5 F3 F4}}$
3 year girth $\underline{\text{F8 F7 F1 F5 F6 F2 F10 F3 F4 F9}}$

With regard to height, during second year, there were four groups, while in the

Table 2

Anova for Height and Girth

Source	2 years height		3 years height	3 years girth
	DF	MSS	MSS	MSS
Block	2	0.229 (4.08%)	0.334 (16.98%)	0.426* (62.18%)
Family	9	5.263** (93.83%)	1.405** (71.43%)	0.124 (16.69%)
Sp1 vs Sp2	1	33.683**	8.296**	0.004
B1 x Fam.	18	0.085** (1.52%)	0.179** (9.1%)	0.118** (15.88%)
Error	270	0.032 (0.57%)	0.049 (2.49%)	0.039 (5.25%)
Total	299			

*, ** = Significant at 5% and 1% levels respectively.

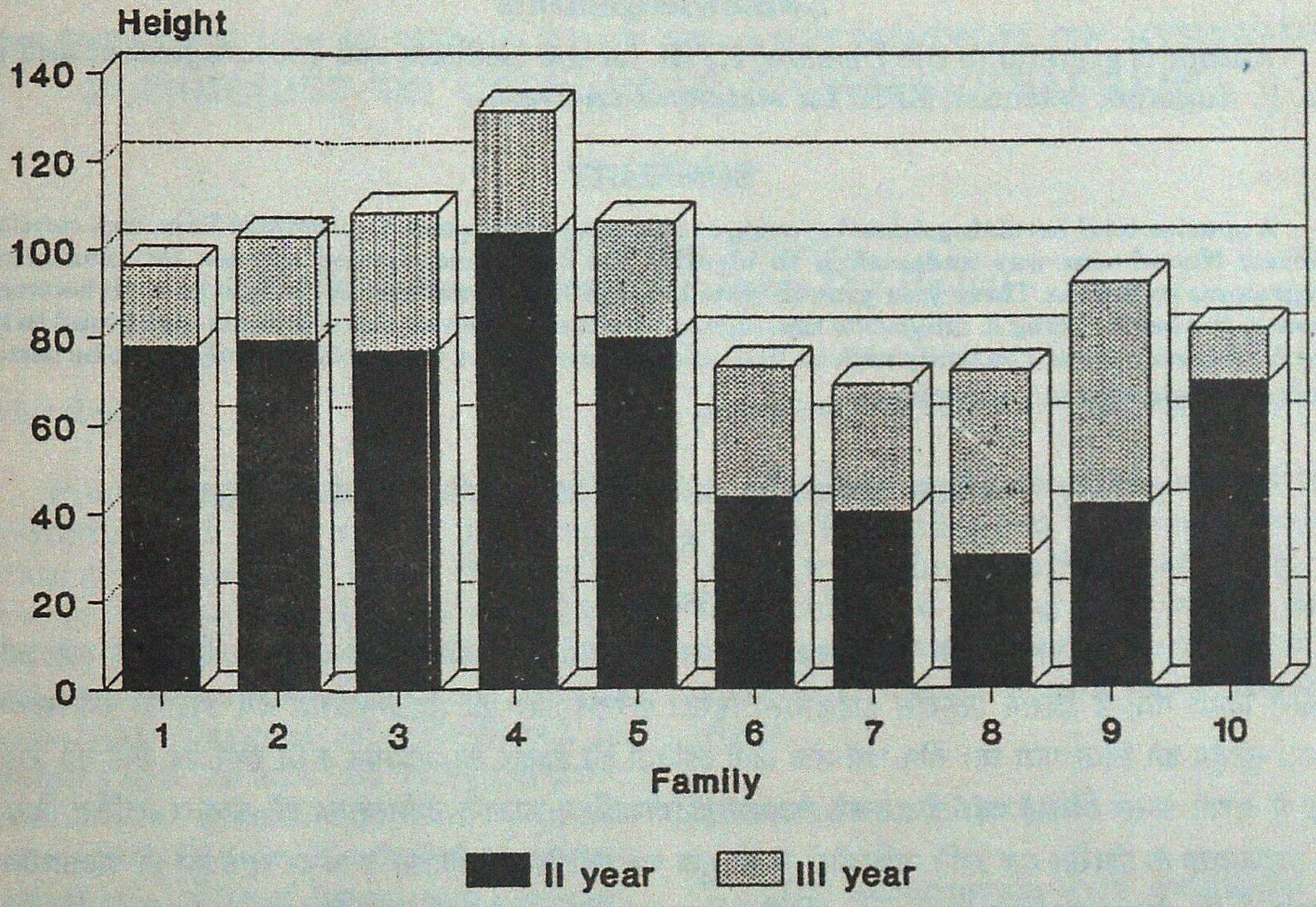
Table 3

Mean height, Girth and Range (cm)

Family	Seed source 2 year	Mean plant height in cm		Mean girth (cm)
		3 year	3 year	
A. integrifolia				
1.	Mother tree Kodanad	78.13*	96.46*	8.4
2.	M.T. 2 Kodanad	79.33*	102.83*	8.8
3.	M.T. 3 Kodanad	76.96**	108.56*	9.3*
4.	M.T. 4 Kodanad	103.6*	131.53*	9.9*
5.	M.T. 5 Kodanad	79.8*	106.23*	8.7
A. triphysa				
6.	Plus tree 3 Kannoth	43.5	73.3	8.8
7.	PT 4 Kannoth	39.9	69.26	8.5
8.	PT 5 Nedumpoil	30.1	72.23	8.4
9.	PT 19 Nedumpoil	41.8	92.26	10.0*
10.	PT 1 Nilambur	69.33*	81.26	9.0*
Range		14-140	21-189	4-15
Mean		64.25	93.39	8.98

* Families better than the average

Fig. 1



third year, it was reduced to two groups. But as far as girth is concerned, not much difference was seen between families. Family No. 8 and 7 were poorest families, while No. 4 was found to be the best for height growth and second best for girth. Its survival rate was also found to be high. The mean plant height and girth for each family and Range and grand mean are given in Table 3.

Though the total growth was good for *A. integrifolia* ssp. *calycina*, the growth rate during third year (after field planting) was more for *A. triphysa* compared to *A. integrifolia*. Growth rate was evidently higher for family Nos 8 and 9 which are trees from Nedumpoli of Wynad Division (Figure 1). To see the trend clearly, it is intended to continue the study for few more years, atleast upto half the rotation.

The better growth performance and pest resistance of *A. integrifolia* ssp. *calycina* indicates its potential as a plantation species in Kerala to partly replace *A. triphysa*. The quality of pest resistance itself is enough for selecting the species for plantation programmes since, pest problem is one of the main reasons for low productivity in *A. triphysa* plantations.

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SUMMARY

A species trial involving *Ailanthus triphysa* (Dennst.) Alston and *A. integrifolia* Lam. ssp. *calycina* (Pierre) Nooteboom was undertaken to identify the better matchwood species for plantation programme in Kerala. Three year growth revealed significant variation for height growth between species, the better being *A. integrifolia* ssp. *calycina*. Unlike *A. triphysa*, this species is also found to be free from insect pests. The study with its limitations shows that *A. integrifolia* ssp. *calycina* to be better species for plantation programmes.

एलेन्थस में अधिक उत्पादकता लाने के लिए इसकी जातियों का चुनाव

ई० पी० इन्दिरा

सारांश

केरल के रोपवन कार्यक्रम के लिए श्रेष्ठतर दियासलाई काष्ठ जाति की पहचान करने के लिए एक वृक्ष जाति परीक्षण किया गया है जिसमें *एलेन्थस ट्राईफायसा* (डेंस्ट) एल्स्टन और *ए० इंटिग्रीफोलिया* लेम उपजाति *कैलिसायना* (पिएर) नूटेबूम को लिया गया था। तीन वर्षों तक दोनों जातियों की बढ़वार का अध्ययन करते रहने पर दोनों की ऊंचाई वृद्धि में काफी अन्तर दिखाई पड़ा और उसने *एलन्थस इंटिग्रीफोलिया* उपजाति *कैलिसायना* को श्रेष्ठतर प्रदर्शित किया। *ए० ट्राईफायसा* के विपरीत यह जाति नाशिकीटों से भी मुक्त पाई गई। अपनी सीमाओं के अन्दर रहते हुए भी यह अध्ययन दिखाता है कि रोपव्रन कार्यक्रम के लिए *ए० इंटिग्रीफोलिया* उपजाति *केलिसायना* इसके लिए ज्यादा अच्छी जाति रहेगी।

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RESISTANCE TO BLISTER RUST BY APPLICATION OF SYSTEMIC FUNGICIDES ON CHIR (*PINUS ROXBURGHII* SARGENT)

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Introduction

Pines constitute one of the most divergent and economically important group of species found in the Himalayas. They protect the watersheds, minimise soil erosion and contribute significantly to saw mill and turpentine industries. *Pinus roxburghii* Sargent is distributed in Siwaliks and the hills and valleys of outer Himalayas extending from Jammu eastward to Bhutan. It is however, absent in Kashmir Valley of Jammu and Kashmir. Chir pine is an important species mainly in the States of Jammu and Kashmir, Himachal Pradesh and Uttar Pradesh. While occurrence in West Bengal is limited to approximately 80 h, where it is found with *Shorea robusta* on an elevation of about 450 m on the lower hill slopes of Rangit Valley in Darjeeling Division (Champion and Seth, 1968). Its altitudinal zonation varies from 450 m to 2300 m. In India, young chir plantations are prone to the attack of *Cronartium himalayense* which forms pycnidial and aecial stages on chir during winter and summer respectively (Bakshi, 1964). The attack is sometimes so severe that 40% plants succumb to the disease, as was reported from Suld in Pauri Garhwal (Anon., 1990). Shukla and Pandey (1993) conducted surveys in Pauri and Tehri of Uttar Pradesh and found many plantations of chir showing stem blisters.

Trials were conducted to control the rust by fungicides and the present paper deals with the experimental trials of fungicides on young chir crops and expressed in the absence or presence of stem blisters in chir during two successive years.

Materials and Methods

The experiments were conducted at Syalkham-2 in a 10 ha plantation of chir done in 1985. The area falls under Nainidanda Range of Additional Soil Conservation Division, Ramnagar (Distt. Nainital, U.P.). The area has a previous history of mortality as beating up operations were done in 1985. Thus the study area has a mixture of some left out trees planted in 1982 and younger trees planted to fill the gaps in 1985. Later the cause of mortality was ascertained to be the formation of clusters of aecial cups in the stem and branches in young chir plants (Fig. 1). The rust was also noticed at the base of older trees aged between 15-20 yrs in the same locality (Fig. 2).

After confirming the presence of rust, the area was demarked into roughly square blocks and 30 young plants of chir were taken in each block. All the trees of one block were treated separately with systemic fungicides like Bavistin (Carbandazim 50% WP), Baycor (Bitertanol 25% WP), Bayleton (Triadimefon 25% WP) and Topsin-M (Thiophanate - Methyl 70% WP). The systemic fungicides were chosen with a view to their ability to penetrate into the system and check the spread of the pathogen, which was also systemic, in comparison to surface fungicides.

The fungicides chosen were reportedly active against rusts. Bavistin is a broad spectrum systemic fungicides which shows fungitoxicity towards Ascomycetes, Deutermomycetes and various Basiodiomycetes. It effectively controls powdery mildew and rusts of cereals and vegetables (Anon, 1981). Bayleton is also effective against cereal rusts (Siebert, 1976), particularly *Puccinia striformis* causing yellow rust of wheat. Brandis *et al.* (1979) reported moderate actively of Baycor against powdery mildews and rusts of wheat. Topsin-M is similarly a broad spectrum systemic fungicide used for both preventive and ourative measures against a number of fungal diseases.

Two concentrations of each fungicide were used on the basis of active ingredient (a.i.) of the fungicide. Thus Bavistin 0.05 and 0.1% (designated as T_1 and T_2), Bayleton 0.1 and 0.2% (T_3, T_4), Topsin-M 0.2 and 0.4% (T_5, T_6) and Baycore 0.05 and 0.075% (T_7,T_8). The control was designated as T_9 and no treatment was given to the plants of control block. Based on the biology of the rust (Bagchee, 1941; Shukla and Pandey, 1993) the sporidia travel to chir plants from its alternate host *Swertia angustifolia* during rainy season and germinate on the needles and enter chir plants, the fungicidal sprays were scheduled so as to hinder the landing and germination of sporidia. Bakshi (1964) opined that the sporidia of *Cronartium himalayense* either enter through tender shoots or through needles in the chir. Needle infection in case of white pine blister rust in America has also been confirmed by Bingham (1983). Ragazzi and Fedi (1992) on the basis of SEM studies of the penetration of *Cronartium flaccidum* concluded that the sporidia enter through stomata.

A total of three sprays of different fungicides in two concentrations were given to the test plants at an interval of 20 days. The first spray was given in the first week of October and the last in the fourth week of November. All the plants were sprayed on the needles, tip and stem till dripping.

The observations were taken in the month of May, in the following year. The parameters taken were the number of plants showing aecial infection, height of the plant, diameter of the plant at base, middle and tip, length of canker, its location either on the main stem or branch and the middle diameter of the canker. The diameter was recorded by an electronic Vernier calipers (Fig. 3). The measurements of height and girth were taken to calculate the total volume of plant. The volume of canker was calculated on the basis of its diameter and length. All the observations were expressed in cm^3.

The observations of all the parameters stated above were again repeated in 1994 and the whole data was computed.

Results and Discussion

The results are presented in Table nos. 1-3. A perusal of Table 1 will show that in the year 1993, the control block showed a

Table 1

Number of plants of chir (Plantation year 1985) infected with aecial cups in different fungicidal treatments, out of a total number of 30 plants treated.

Year	Control	Bavistin		Bayleton		Topsin-M		Baycor	
		0.05	0.1	0.1	0.2	0.2	0.4	0.05	0.075
1993	11	00	00	00	2	1	2	2	2
1994	9	00	00	00	00	2	2	3	00
No. of Plants dead	3	00	00	00	00	00	00	2	00
Total of 1994	12	00	00	00	00	2	2	5	00

Table 2

Total volume of plants of Pinus roxburghii and the volume of canker (cm³) under different fungicidal treatments.

Year	Volume in Cm³	Control	Bavistin		Bayleton		Topsin-M		Baycor	
		T_9	T_1 0.05%	T_2 0.1%	T_3 0.1%	T_4 0.2%	T_5 0.2%	T_6 0.4%	T_7 0.05%	T_8 0.075%
1993	Total of all trees	36238.91	31226.08	53948.48	33495.27	25361.98	20106.79	27014.2	35839.34	30290.20
	Total of all cankers	6808.46	0	0	0	1752.73	514.19	879.69	1262.58	147.65
1994	Total of all trees	28051.87*	36870.01	63237.04	49195.00	32387.24	67051.42	43004.14	33456.36**	54995.88
	Total of all cankers	6923.47	0	0	0	0	48.29	336.94	2563.56	0

Total number of treatments given - T_1 to T_9
Total number of plants treated - 30 per treatment.

* Represent volume of 27 plants as three plants were found dead.

** Represents volume of only 28 plants as two plants were found dead.

total of 11 plants with aecial infection in the main stem as well as on side branches. On the other hand no infection was noticed either in Bavistin or Bayleton (0.1%) treated blocks. The effectiveness of 1992 sprays in eliminating and checking aecial development in the summer of 1993 can further be elaborated. The higher concentration of Bayleton (0.2%) showed only two plants infected with the rust. In Topsin-M treated blocks only one plant in lower concentration (0.2%) and two plants

Table 3

Mean value in respect of canker volume (cm^3) under different fungicidal treatments along with significance and bar diagrams.

Year	Mean of bar diagram									Significance
1993	T_9 (Control)	T_4	T_7	T_6	T_5	T_8	T_1	T_2	T_3	
	226.94	58.42	42.08	29.32	17.14	4.92	0	0	0	***
1994	T_9 (Control)	T_7	T_6	T_5	T_8	T_4	T_3	T_2	T_1	
	230.78	85.45	11.23	1.61	0	0	0	0	0	***

*** Indicates significance at 0.1% level of probability

in higher concentration (0.4%) were infected, whereas in Baycor treated plots two plants each in lower and higher concentrations were observed with aecial infection.

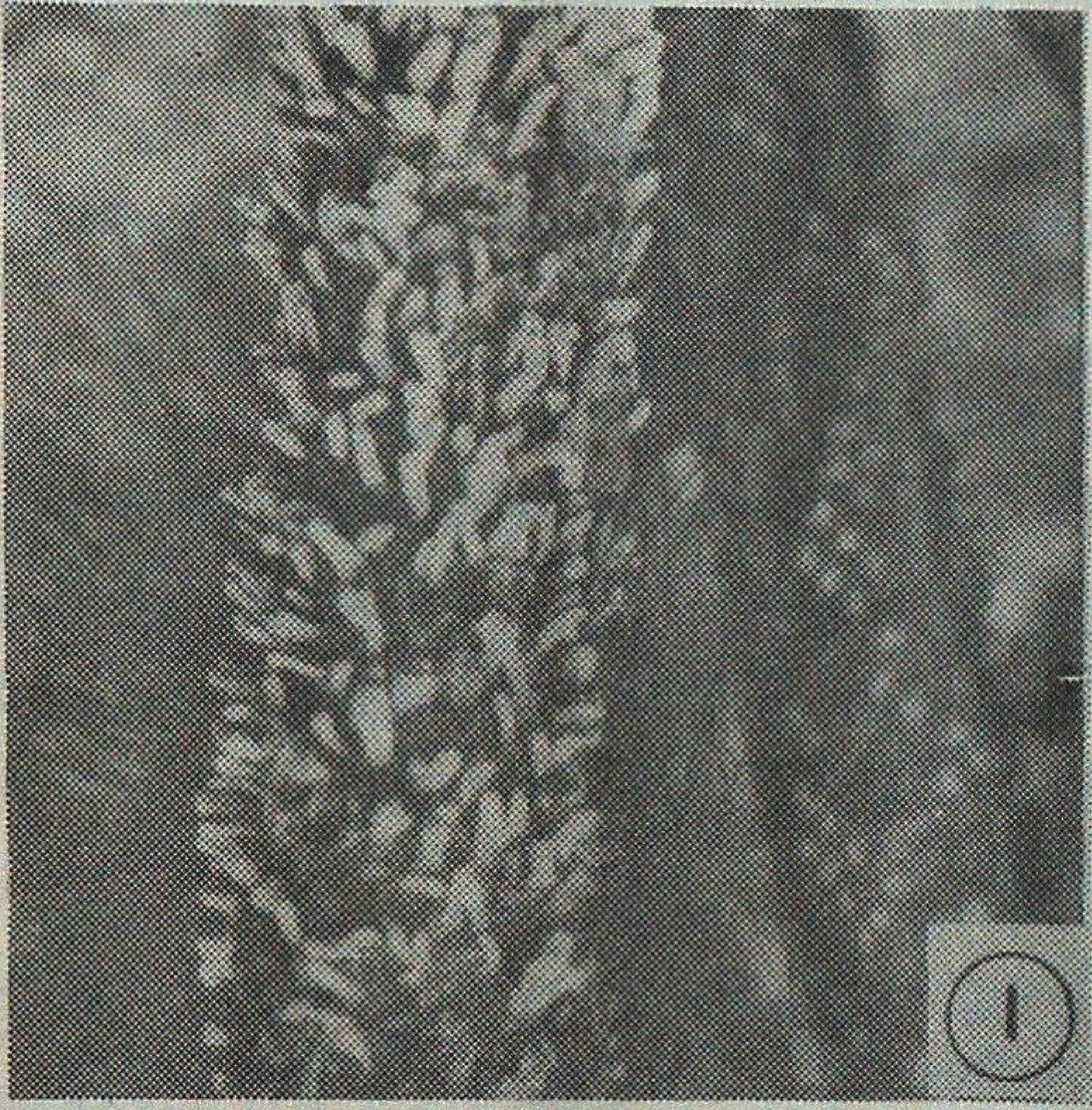
The comparative observations taken in the year 1994 are also depicted in the same table. In control (T_9) a total of 9 plants showed aecial infection and 3 plants were found dead having a total of 12 infections. No infection and no mortality could be seen in Bavistin and Bayleton treated blocks. The remission of symptoms was even noted in two plants each in case of Bayleton (0.2%) and Baycor (0.075%). In Topsin-M treated blocks two plants were infected in each of the lower and higher concentrations, whereas in the lower concentration of Baycor there were two plants found dead and 3 with aecial infection. The higher concentration of Baycor, however, was effective in controlling the infection, as stated above.

The observations on the total volume of trees and the total volume of canker are presented in Table 2. A glance at the table will indicate that in 1993, out of the total volume of all the trees (36238.91 cm^3) the volume of canker was 6808.46 cm^3. The maximum cankered area was noticed in the treatments of Bayleton (0.2%)-1752.73 cm^3, Baycor (0.05%)-1262.58 cm^3 and Topsin-M (0.4%)-879.69 cm^3. No cankers were formed in Bavistin (T_1 and T_2) and Bayleton (T_3) treatments. The least cankered area was formed in Baycor (0.075%)-147.63 cm^3 in replicate No. T_8.

The repeat observations taken in 1994 showed total volume of all the trees as 28051.87 cm^3. The loss in the volume was due to mortality of 5 nos. of plants in 1994 in the study area. But the total cankered area was measured as 6923.47 cm^3. No cankers could be observed in Bavistin (T_1, T_2), Bayleton (T_3, T_4) and Baycor (T_8) treatments. There was marked reduction in the volume of cankers in Topsin-M (T_5, T_6) treatment, whereas lower concentration of Baycor (T_7) showed no effect in checking the canker development.

The statistical analysis of the fungicidal treatments is presented in Table 3. The table shows that in the year 1993 all treatments were significant as compared to control at 0.1% level of probability. Again in 1994 all the treatments showed significance at 0.1% level of probability as compared to control. Statistically three most effective treatments in 1993 were T_3 (Bayleton), T_2 and T_1 (both lower and higher concentrations of Bavistin). The least effective treatments were T_4, T_7 and T_6. The final observations in 1994 showed the three most effective treatments as T_1, T_2 (Bavistin) and T_3 (Bayleton) and three least effective treatments as T_7 (Baycor), T_6 and T_5 (both Topsin-M).

Figs 1-3



Stem rust of chir caused by *Cronartium himalayense*.

1. Aecial cups of the rust on young twigs.
2. Aecial cups on the old stem (20 years).
3. Measuremen of the diameter of the canker by electronic claipers

Thus on the whole it can be concluded that Bavistin at 0.05 and 0.1% concentrations and Bayleton at 0.1 and 0.2% concentrations were the most effective fungicides in checking the spread of stem rust of chir.

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SUMMARY

Effect of systemic fungicides like Bavistin, Bayleton and Topsin-M and Baycor was studied on the development of stem blisters caused by *Cronartium himalayense* Bagchee on *Pinus roxburghii* Sargent for two successive years. Bavistin and Bayleton were found to be very effective at lower and higher concentrations.

चीड़ *(पाइनस रोक्सबर्घिआई* सार्जेण्ट) में विधिबद्ध कवकनाशी उपयोग करके फफोला गैरिक के प्रति प्रतिरोधिता लाना

ए० एन० शुक्ल

सारांश

बाविस्टिन, वायलेटन और टाप्सिन-एम और बायकोर जैसे विधिबद्ध कवकनाशी उपयोग में लाकर *पाइनस राक्सबर्घिआई* सार्जेण्ट में *क्रोनेर्टियम हिमालयंसे* बाग्ची लगने से उसके तने में पड़ने वाले फफोलों का विकास होने पर पड़ने वाले प्रभावों का अध्ययन निरन्तर दो वर्षो तक किया गया। कम और अधिक संकेन्द्रणों में लेकर प्रयोग करने पर इसको रोकने के लिए बाविस्टिन आर बायलेटन बहुत प्रभावकारी पाए गए ।

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ESTIMATING SEED QUALITY IN HARD SEEDED LEGUMINOUS TREES BY ACCELERATED AGING AND LEACHATE CONDUCTIVITY

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Introduction

Accelerated aging and leachate conductivity are tests for seed vigour which are widely used on agricultural seeds (Anon., 1985). The principle behind leachate conductivity measurements for estimation of seed quality is simple; deterioration of seeds due to either aging or to mechanical damage, leads to leakage of cellular constituents, many of which are electrolytes. High conductivity, indicating abundant electrolytes means poor seed quality. Accelerated aging; a method of stress test, in which seeds are subjected to higher temperature at 100% RH for different durations, has been effectively used to estimate seed vigour and storability in agronomic crops (Delouch and Baskin, 1973; Anon., 1983).

Limited research (Bonner, 1991; Blanche *et al.,* 1990; Pitel, 1982) has demonstrated that both tests can be used to predict seed vigour (quality) of several conifer and hardwood species. The utility of these test in assessing the seed vigour of leguminous tree species has not been studied much. Since the seeds of leguminous trees possess hard seed coats, they may require temperatures during aging which are different from those used to other seed types. Also the standard pretreatment of these seeds involves some kind of scarification which could seriously alter the relationship of conductivity to germination. Intact hard seeds might not leach enough electrolytes to detect differences, while scarified seeds leach too much.

This study was undertaken with two hardseeded species, viz., *Gleditsia trichanthos* and *Robinia pseudacacia* to determine the potential of leachate conductivity and accelerated aging for evaluating seed quality in this seed type.

Materials and Methods

Southern Research Station, Forestry Sciences Laboratory, USDA, Stark Ville, MS, USA, provided seeds for this study.

In the first test, the seeds of both the species after weighing were scarified in concentrated sulphuric acid for one hour. After washing the seeds in running tap water, these were leached in deionized water for different time intervals viz., 5, 10, 15, 20, 25 and 30 hours. After these timings the electrical conductivity of the leachates was determined along with two water blanks with the help of YSI model 32 electric conductivity meter (Bonner, 1991). In this test 25 and 50 seeds and *Gleditisia trichanthos* and *Robinia pseudacacia,* respectively were used in each treatment with four replicates. The conductivities were expressed as microsiemans μ Sg^{-1} after subtracting the value of water blanks.

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The samples were then placed on moist cellulose wedding in germinator at alternating night and day temperature of 20^0 and 30^0 with dark and light regimes of 16 and 8 hours, respectively. Germination was recorded daily for 14 days and was expressed as per cent normal germination of viable seeds. Seeds were considered germinated when the radicle and cotyledons turn greenish in colour.

In the second test, the seeds of both the species were kept for accelerated aging according to the procedures of AOSA (Anon., 1983). Seeds were treated with 10% chlorox solution for 1 minute to check fungal attack during aging. These seeds were placed in covered plastic boxes, 14 x 14 x 5 cm, each containing a bronze mesh seed holder. 25 and 50 seeds of *G. trichanthos* and *R. pseudacacia,* respectively were placed in a single layer on this screen wire above 40 ml of deionized water in each box. The boxes were then placed in a stults scientific accelerated aging chamber maintained at either 39^{0}C, 41^{0}C or 45^{0}C and a constant relative humidity of 100%. Seeds were withdrawn at specified time interval of 24 hours, 48 hours, 72 hours and 120 hours, respectively. Each time - temperature combination was replicated 4 times and the samples were weighed prior to aging. Later on the seeds were leached in deionized water for 24 hours to measure the leachate conductivity. Seeds of both the species were nicked with the help of clippers and were kept for germination in the seed germination chamber as described previously.

Results and Discussions

Table 1 represent the datum of the first test i.e., release of electrolytes overtime along with germination percentages of both the species. Increasing trend was observed in release of electrolytes from 0 to 30 hours in both the species while maximum germination i.e. 96.6% and 73.3% was observed after 15 hours of soaking in *G. trichanthos* and *R. pseudacacia,* respectively.

After 15 hours of seed soaking germination percentage decreases in both the species which is probably due to release of more electrolytes overtime as leachate conductivity increases from 15.79 to 41.2 and 28.54 to 210.53 μ Sg^{-1} in case of *G. trichanthos* and *R. pseudacacia,* respectively. Release of electrolytes overtime was observed less in case of *G. trichanthos* in comparison to *R. pseudacacia,* which is due to hard seed coat which restrict the release of electrolytes.

The results of second test suggest that accelerated aging is a potentially valuable test of seed vigour in hard seeded legumes. Table 2, shows that *G. trichanthos* seeds are quite resistant to accelerated aging for shorter time even at higher temperature while *R. pseudacacia* is less resistant to aging temperature (Table 3).

Germination percentage in case of aged seeds of *G. trichanthos* were increased from 86% to 96% upto 48 hours of aging at 39^{0}C, while it decreases at 41^{0}C and 45^{0}C upto 120 hours. Behaviour of aged seeds of *R. pseudacacia* was also the same as *G. trichanthos,* though germination percentages were observed less.

Leachate conductivities of aged seeds of both the species were observed in increasing order at all three temperatures (39^0C, 41^0C and 45^0C) with all the time intervals (24 to 120 hours) which is probably due to loss of membrane integrity (Basavarajappa *et al.*, 1991). While comparing leachate conductivity and germination percentage of scarified seeds of both the species (Table 1) with the accelerated aged seeds of the same (Table 2 and 3), it seems that there is little relationship between leachate conductivities and germination percentages

Table 1

Leachate conductivity (LC) overtime and germination percentage of Gleditisia trichanthos and Robinia pseudacacia seeds.

Time of soaking (Hours)	*Gleditisia trichanthos*		*Robinia pseudacacia*	
	Germination (%)	LC (μ Sg^{-1})	Germination (%)	LC (μ Sg^{-1})
0	92.60	15.79	64.60	28.54
5	94.00	22.72	64.60	129.35
10	94.60	35.44	70.60	156.25
15	96.60	36.31	73.30	174.07
20	96.60	38.55	71.30	207.51
25	95.30	39.12	60.00	208.81
30	94.00	41.20	60.00	210.53

Table 2

Germination percentage and leachate conductivity (L.C) of A.A. G. trichanthos seed.

Temperature (^{0}C)	Aging period (Hours)							
	24		48		72		120	
	Germination (%)	LC(μSg^{-1})	Germination (%)	LC(μ Sg^{-1})	Germination (%)	LC(μ Sg^{-1})	Germination (%)	LC(μ Sg^{-1})
39	86.00	5.73	96.00	7.70	88.00	12.99	86.00	15.14
41	92.00	7.17	88.00	7.83	80.00	14.94	80.00	17.13
45	92.00	7.97	86.00	8.82	80.00	15.11	66.00	22.00

Table 3

Germination percentage and leachate conductivity (LC) of A.A. R. pseudacacia seed

Temperature (^{0}C)	Aging period (Hours)							
	24		48		72		120	
	Germination (%)	LC(μSg^{-1})	Germination (%)	LC(μ Sg^{-1})	Germination (%)	LC(μ Sg^{-1})	Germination (%)	LC(μ Sg^{-1})
39	36.00	106.77	49.00	124.75	35.00	133.93	17.00	279.65
41	48.00	176.39	40.10	186.08	34.10	220.15	2.00	310.89
45	49.00	181.35	37.00	260.75	30.00	295.00	2.00	410.25

which is due to that scarified seeds yielded more conductivities.

Based on the results of the above study we conclude the following :

- Leachate conductivity test appears very promising for intact leguminous seeds but not for scarified seed.
- 15 hours of soaking for scarified seeds of *G. trichanthos* and *R. pseudacacia* is sufficient to get some correlation between conductivity and germination percentage.
- Accelerated aging shows considerable promise as a test for seed vigour testing in hard seeded legumes.

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SUMMARY

The potential of leachate conductivity and accelerated aging for evaluating seed quality of *Gledisia trichanthos* and *Robinia pseudacacia* have been studied and the results are presented in this paper.

कड़े बीजों वाले शिम्बिवर्गीय वृक्षों में त्वरित जराकरण और पारच्यवित संचालकता द्वारा बीज गुणवत्ता का अनुमानन

परमजीत सिंह, ओमवीर सिंह व वीणा चन्द्रा

सारांश

ग्लेडीसिया ट्राइकेथोस और *रोबिनिया स्यूडोअकेसिया* के बीजों की गुणावत्ता का अनुमान लगाने के लिए पारच्यवित संचालकता और त्वरित जराकरण की संभावनाओं का अध्ययन किया गया तथा उसके परिणाम इस अभिपत्र में दिए गए हैं।

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INTERRELATED EFFECTS OF TEMPERATURE AND CONTAINER ON LONGEVITY OF *TOONA CILIATA* M. ROEM SEED

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Introduction

Toona ciliata is cultivated for its timber and fuelwood values and is commonly called toon, is a large deciduous tree. It is distributed in the forests of sub-Himalayan tracts and the valleys of the outer Himalayas upto an elevation of 1200 m. The species is of tremendous potential for reclamation of degraded lands and hence included under social forestry and wasteland afforestation programmes. The tree is propagated through seeds, which are short lived i.e. remain viable for 3 months under ordinary conditions (Nautiyal and Thapliyal, 1993). In North India, the seeds ripen in the month of June. Therefore, it is recommended to sow seeds soon after collection. But if sowing is done in the month of July in the frost prone localities, the seedlings suffer frost injury. Therefore, it is better to sow seeds in the month of February-March, so that seedlings become enough harder to withstand frost injury. Therefore, the seeds are required to be stored for 8-9 months. The present study was therefore undertaken to evolve storage method to prolong seed longevity.

Materials and Methods

Seeds of *Toona ciliata* were collected from the area of the Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (H.P) on June 16, 1993. For the extraction of seeds, capsules were kept in the sun for 6-7 hours. Immediately, after collection seeds were tested for their germinability under laboratory conditions.

For studies on seed longevity, seeds were stored at three different storage temperatures - room temperature. 0^0C and 10^0C, in four different containers, namely-earthen pot, canvass bag, polythene bag and plastic bin, and for 12 different storage durations - 1, 2, 3 .... 12 months. 200 gms seed was stored in each of the four different containers and under each storage temperature were kept for one year.

After every 30 days a representative sample was drawn from four different containers stored under each storage temperature and tested for germination capacity and moisture content. Four replicates of 100 seeds each were taken and sown in trays containing wet germination blotter paper. The germination was carried out under controlled conditions of temperature (25^0C) in seed germinator. Mean of 4 replicates was taken for germination percentage and the data was subjected to statistical analysis following the procedure described by Gomez and Gomez (1984).

Results and Discussions

Freshly collected seeds gave a germination per cent of 99.7 per cent and were having 24.9 per cent moisture content. Wide range of variations in the longevity of *Toona ciliata* seeds under different storage conditions is apparent.

Storability at different storage temperatures : Storage temperature of 0°C resulted highest germination percentage of 95.6 and was followed by 83.7 per cent at 10°C. The lowest germination per cent of 17.2 per cent was recorded in seed stored at room temperature. Highest per cent moisture content of 19.4 per cent was recorded at 0°C and 17.6 per cent at 10°C. Minimum per cent moisture content of 11.0 per cent was recorded at room temperature (Table 1). Low viability at room temperature is due to the rapid loss in the seed moisture content at room temperature. Better retention of viability at 0°C is possibly due to the reason that biological processes in seeds are slowed down at near freezing temperatures, thus enhancing seed longevity. These results are in agreement with the findings of Ezumah (1986) in *Azadirachta indica* and Tompsett (1985) in *Shorea robusta*.

Storability in different storage containers : Maximum germination of 73.9 per cent was recorded in seeds stored in polythene bag, followed by 73.7 per cent in the plastic bin stored seeds. The lowest germination of 47.5 per cent was recorded in earthen pot container. Similarly, per cent moisture content also followed a trend parallel to that of germination per cent (Table 1). This shows that the containers which maintained higher per cent moisture content retained higher per cent germination.

Interaction effect of temperature x container x storage duration : The combined interaction effect of temperature, container and duration is presented in Table 2.

Comparison of storage temperatures at the same combination of storage container and duration revealed that 0°C storage temperature outperformed all the others. Comparing the storage containers at similar storage temperature and duration level, it was found that polythene bag recorded invariably higher values for germination per cent at 0°C whereas plastic bin gave good results as compared to polythene bag at room temperature and 10°C storage temperature. A clear pattern showing fall in per cent germination emerged when the twelve storage durations were compared

Table 1

Effect of storage temperatures and containers on the germination and moisture content of Toona ciliata seeds in storage.

Treatments	Germination (%)	Moisture content (%)
A. Storage temperatures (°C)		
T_1 : Room temperature	17.21	11.05
T_2 : 0°C	95.59	19.39
T_3 : 10°C	83.75	17.62
S. Ed.	0.16	0.04
$LSD_{0.05}$	0.36	0.12
B. Storage containers		
C_1 : Earthen pot	47.47	17.10
C_2 : Canvass bag	54.13	17.46
C_3 : Polythene bag	73.94	19.63
C_4 : Plastic bin	73.70	19.54
S. Ed.	0.22	0.03
$LSD_{0.05}$	0.45	0.07

Table 2

Effect of Temperature X Container X Duration interactions on the germination of Toona ciliata seeds during storage.

Temp. X containers	Storage durations (months) 1	2	3	4	5	6	7	8	9	10	11	12
T_1C_1	92.50	30.75	0.0	—	—	—	—	—	—	—	—	—
T_1C_2	87.00	28.00	0.0	—	—	—	—	—	—	—	—	—
T_1C_3	96.00	96.00	74.00	17.75	5.00	0.0	—	—	—	—	—	—
T_1C_4	94.50	91.50	77.25	26.75	9.25	0.0	—	—	—	—	—	—
T_2C_1	98.00	96.50	96.75	95.75	95.50	95.50	95.00	94.00	94.00	93.50	93.50	90.00
T_2C_2	98.75	97.75	97.50	97.00	95.00	94.50	95.00	94.50	95.50	95.00	94.00	91.00
T_2C_3	99.25	98.25	97.25	97.75	97.50	92.50	96.50	95.50	95.00	95.50	95.50	93.00
T_2C_4	98.25	98.25	97.25	97.50	96.50	96.00	95.00	95.00	94.50	94.00	93.50	89.50
T_3C_1	97.75	96.75	90.50	91.00	80.50	76.00	74.50	68.00	68.50	64.00	40.00	39.00
T_3C_2	98.00	97.25	92.25	92.50	91.00	90.50	82.50	73.00	74.50	67.50	57.00	47.50
T_3C_3	98.25	97.75	97.75	97.00	97.00	96.50	94.00	91.75	89.00	82.00	74.00	64.00
T_3C_4	98.75	96.50	96.00	93.50	93.50	93.50	93.50	93.00	92.00	89.00	84.00	80.00

	S.Ed.	$LSD_{0.05}$
For two storage temperatures at the same combination of storage duration and container	1.47	3.32
For two containers at the same combination of temperature and duration	1.49	3.02
For two durations at the same combination of temperature and container	1.45	2.84

amongst themselves. Loss in seed viability with progressive increase in period of storage duration can be attributed to aging of seeds (Harrington, 1973). The fall in the per cent germination was rapid in the canvass bag and earthen pot seeds at room temperature where the germination per cent came down to zero after 3 months of storage. Further scrutiny of the data led to the inference that decline in per cent germination was least in polythene bag seeds stored at 0°C temperature for various storage durations. Polythene bag seeds stored at 0°C temperature recorded 99.2 per cent germination after one month and 93 per cent after one year of storage.

SUMMARY

Keeping in view low seed longevity, seed storage studies were carried out in *Toona ciliata*. Seeds were stored in four different containers kept at three different temperatures for one year. It was found that polythene bag seeds kept at 0°C temperature maintained 93 per cent germination after one year in storage.

तुना सिलियाटा एम० रोम के बीजों की दीर्घजीविता पर तापमान और आधान के परस्परक्रियता प्रभाव

गुरदेव चंद व एस०डी० भारद्वाज

सारांश

बीजों की कमजीविता को ध्यान में रखते हुए *तुना सिलियाटा* के बीजों के भंडारण पर कुछ अध्ययन किए गए। बीजों को तरह-तरह के आधानों में विभिन्न तापमानों पर एक वर्ष तक भंडारित किया गया। परिणामतः यह देखने में आया है कि पॉलिथीन थैलियों में बीजों को 0° सें० तापमान पर भंडारण में एक वर्ष तक रखने के बाद ही उनका अंकुरण 93% बना रहा।

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MYCOFLORA OF NEEM SEEDS

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Introduction

Azadirachta indica A. Juss, commonly called Neem is a multipurpose tree species well suited for drier locations in Social Forestry plantations and wasteland afforestation. Neem is propagated through seeds, therefore, healthy seeds play an important role in the production of quality planting stock. Poor seed germination in the nurseries may be due to infected seed lots. It is a common observation that the mature fruits of neem attract a large number of molds. Common molds which colonise the seeds in storage are responsible for the partial or total loss of viability. Whittle (1977), Christenson (1973), and Semeniuk (1954) studied the mycoflora of cereals in storage and hypothecated that the seed infection either originates from the soil or from decaying floral parts due to invasion by saprobes.

Mujal and Sharma (1975), Hong (1981), Waskikar *et al*. (1987) and Tiwari and Sharma (1981) worked on seeds of different tree species and listed seed mycoflora and its effect on the germination of seeds. These fungi induce a continuous biochemical and physiological change in the seeds damaging the seed coat and affecting the viability (Christenson, 1973). They may also attack and kill the embryo of seeds under suitable conditions of moisture and temperature.

Materials and Methods

Seed of *A. indica* were collected from 24 different sources covering nine states, namely, Uttar Pradesh, Haryana, Rajasthan, Madhya Pradesh, West Bengal, Orissa, Maharashtra, Andhra Pradesh and Karnataka. A seed lot from each source was randomly drawn to study the seed mycoflora. Externally and internally seed borne fungi were studied as per the following method.

For externally seed-borne fungi, seeds were plated on malt agar without surface treatment whereas for internal seed-borne fungi, the seeds were first washed on running water to remove the surface contaminants. After thorough washing the seeds were surface sterilized with 0.1 per cent mercuric chloride solution for 2 minutes and immediately rinsed on sterilized water for 3-4 times to remove all traces of mercury. Ten seeds were plated on malt agar medium in a Petri dish and total of five replicates were prepared for each source. The plates were incubated for 7 days in an incubator at 25±1°C and the fungi were isolated and identified as listed in (Tables 1 and 2).

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Table 1

Fungal flora of neem seeds from different sources.

State	Locality	Treatment	Fungal species											
			1	2	3	4	5	6	7	8	9	10	11	12
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Uttar Pradesh	Clutterbuckganj	T1	-	+	+	+	-	-	+	+	+	-	-	+
	Bareilly	T2	+	+	-	+	-	-	-	-	-	-	+	-
	Compierganj	T1	-	+	-	-	+	-	-	-	+	-	-	-
		T2	-	+	-	-	+	-	-	-	-	+	-	-
	Hastinapur	T1	+	-	-	+	-	-	-	+	-	-	-	-
	Meerut	T2	+	-	-	-	-	-	-	-	-	+	-	-
	Swargmarg	T1	-	-	-	-	-	-	-	-	-	-	-	+
	Mathura Cantt.	T2	-	-	-	-	-	-	-	-	-	-	-	+
	Virandaban Block	T1	-	+	-	-	-	-	-	-	-	-	-	-
	Mathura	T2	-	+	-	-	-	-	-	-	-	-	-	+
	Paliya	T1	+	+	-	-	-	-	-	-	-	-	-	+
		T2	+	+	-	-	-	-	-	-	-	-	-	-
	Kasi Range, Chandrapur Block, Varanasi	T1	+	+	-	-	-	-	-	-	-	-	-	-
		T2	+	+	-	-	-	-	-	-	-	-	-	-
Haryana	Sirsa	T1	+	+	-	+	-	-	-	-	-	-	-	-
		T2	+	+	-	+	-	-	-	-	-	-	-	-
Rajasthan	Banad	T1	-	-	-	+	-	+	-	-	-	-	-	-
		T2	-	-	-	+	-	+	-	-	-	-	-	-
Madhya Pradesh	Jabalpur	T1	+	-	-	-	-	-	-	-	-	-	-	-
		T2	+	-	-	-	-	-	-	-	-	+	-	-
West Bengal	Ranibandh-Midnapur	T1	-	-	-	-	-	-	-	+	-	-	-	-
		T2	+	-	-	-	-	-	-	-	-	-	-	-
Orissa	Rayagada	T1	+	+	-	+	-	-	-	-	-	-	-	-
		T2	+	+	-	+	-	-	-	-	-	-	-	-
	Keonjhar	T1	-	+	-	+	-	-	-	+	-	-	-	-
		T2	-	+	-	+	-	-	-	+	-	-	-	-
	Rairakhol	T1	-	-	-	-	-	-	+	-	-	-	-	-
		T2	+	-	-	-	-	-	+	-	-	-	-	-
Maharashtra	Jalgaon	T1	+	+	+	-	-	-	-	+	+	-	-	-
		T2	+	+	+	-	-	-	-	-	-	+	-	-
	Sangli	T1	-	-	-	-	-	-	-	+	-	-	-	-
		T2	+	-	-	-	-	-	-	-	-	-	-	+
	Poona	T1	+	-	-	-	-	-	-	-	-	-	-	-
		T2	+	-	-	-	-	-	-	-	-	-	+	-

Contd...

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Nanaj	T1	+	-	-	-	-	+	-	-	-	-	-	-
		T2	+	-	-	-	-	+	-	-	-	-	-	-
	Akola	T1	-	-	-	-	-	-	-	-	-	-	-	-
		T2	+	-	-	-	-	-	-	-	-	-	-	-
Andhra Pradesh	Narsimapally	T1	-	+	-	-	-	+	-	-	-	-	-	+
	Hyderabad	T2	-	+	-	-	-	-	-	-	-	-	-	+
	Medak	T1	-	+	-	-	-	-	-	-	-	-	-	-
		T2	+	-	-	-	-	-	-	-	-	-	-	-
Karnataka	Gadag	T1	-	+	-	+	-	+	-	-	-	-	-	-
		T2	-	+	-	+	-	+	-	-	-	-	-	-
	Mandaya	T1	-	+	+	+	-	-	-	-	-	-	-	-
		T2	-	+	+	+	-	-	-	-	-	-	-	-
	Bellary	T1	-	+	-	+	+	-	-	-	-	-	-	-
		T2	-	+	-	+	-	-	-	-	-	-	-	-

Treatments : 1-*Fusarium solani, 2- Aspergillus niger, 3-A. flavipes, 4-A. fumigatus, 5-A. luchuensis, 6-A. flavus, 7-A. Cephalosporium roseo-griseum, 8-Penicillium* sp., *9- Alternaria alternata, 10-Mycelia sterilia, 11-Pythium* sp., *12*-Bacteria. + = fungus present. - = fungus absent. T1 = untreated. T2 = Treated seeds.

Results

The data recorded for the presence of seed mycoflora from various seed sources is presented in Table 1. A total number of eleven fungal species belonging to six genera together with one bacterium and mycelia sterilia were recorded from unsterilized seeds. The most frequently isolated genera were *Aspergillus* represented by six species followed by *Fusarium (F. solani), Mycelia sterilia* and bacteria (Table 2). The other genera of less frequency were *Penicillium, Cephalosporium, Pythium* and *Alternaria.*

Fusarium solani, a pathogenic fungus was isolated from the seeds from different localities including, Bareilly, Haastinapur, Paliya and Varanasi (Uttar Pradesh), Sirsa (Haryana), Jabalpur (Madhya Pradesh), Midnapur (West Bengal), Rayagada, Rairakhol (Orissa), Medak (Andhra Pradesh), Jalgaon, Sangli, Poona, Nanaj, Akola (Maharashtra). In case of seeds from Bareilly (Uttar Pradesh), Ranibandh (West Bengal), Sangli, Akola (Maharashtra), Medak (Andhra Pradesh), *F. solani* was present on the seed coat as well as on embryo showing its internal seed born character. Severely infected seeds in which embryo is affected will not germinate but slightly infected seed will germinate to surve as infection centre in the field causing significant loss. Internally infected seeds fail to germinate where as seeds with surface infection germinate and at the same time serve as infection source.

Fusarium solani is an important pathogen responsible for wilt disease of *Azadirachta indica* seedlings reported from Kerala State in recent past (Sankaran *et al.*, 1986). Its presence as a frequent component of neem seed mycoflora as revealed in the present study is of significance as surface mould of seeds of tree species have been reported to reduce germination percentage as compared with control in pathogenicity tests (Mittal, 1983) affecting seedling production and offsetting planting targets.

Table 2

Incidence of infection and dominant fungal species in different seed lots.

State	Locality	Infection (%)	Dominant species
Uttar Pradesh	Clutterbuckganj Bareilly	80	*Asperigillus flavipes, A. niger*
	Compierganj	60	*A. lucheunsis, A. niger*
	Hastinapur, Meerut	80	*Fusariom solani, A. Fumigatus*
	Swargmarg, Mathura Cantt	2	*Mycelia sterlia*, Bacteria
	Virandaban Block, Mathura	10	*Bacteria, A. niger*
	Ksai Range, Chandrapur Block, Varanasi	96	*F. solani, A. niger*
	Baliya	100	*F. Solani, A. niger*, Bacteria
Haryana	Sirsa-Hisar	90	*F. solani, A. niger*
Rajasthan	Banad	80	*A. flavus, A. fumigatus*
Madhya Pradesh	Jabalpur	80	*F. solani.*
West Bengal	Ranibandh-Midnapur	86	*Penicillium* sp., *Fusarium solani*
Orissa	Rayagada	80	*F. solani, A. niger*
	Keonjhar	94	*A. fumigatus*
	Rairakhol	50	*Cephalosprium roseogreseume.*
Maharashtra	Jalgaon	60	*A. flavipes, Alernaria alternata*
	Sangli	46	*Fusarium solani, Penicillium* spp.
	Poona	100	*F. solani, Pythium* sp.
	Nanaj	50	*A. flavus, F. solani*
	Akola	16	*F. solani*
Andhra Pradesh	Narsimapally Hyderabad	90	*A. niger*, Bacteria
	Medak	100	*A. niger.*
Karnataka	Gadag	50	*A. fumigatus, A. niger*
	Mandaya	90	*A. fumigatus, A.niger*
	Bellary	50	*A. niger. A. lucheunsis*

SUMMARY

Mycoflora associated with the seeds of neem, *Azadirachta indica* **from different sources is reported. Six fungal genera representing** *Fusarium, Aspergillus, Penicillium. Cephalosporium, Alternaria* **and** *Pythium,* **apart from** *Mycelia sterelia* **and bacteria were isolated. Among these the dominant species were** *Aspergillus niger, A. fumigatus* **and** *Fushrium solani.*

नीम के बीजों के कवक-पादप

कमला उनियाल व डी०पी० उनियाल

सारांश

नीम, *अजेडिरेक्टा इण्डका* के बीजों से संबद्ध कवकपादपों को विभिन्न स्रोतों से सूचित किया गया है। *माइसेलिया स्टेरेलिया* के अतिरिक्त छह अन्य अर्थात् *फ्यूजेरियम*, *एस्परगिल्लस*, *पैनिसिलियम*, *केफालोस्पोरियम*, *आल्टरनेरिया* और *पायथियम* प्रजातियों के कवक और शाकाणु इनसे पृथक किए गए हैं। इनमें सबसे अधिक प्रमुख जातियाँ *एस्परगिल्लस नाइगर*, *ए० फ्यूमिगेटस* और *फयूजेरियम शोलनाइ* थी।

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A PRELIMINARY NOTE ON THE ATTENUATION OF MICROWAVES BY FEW WOOD SPECIES

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Introduction

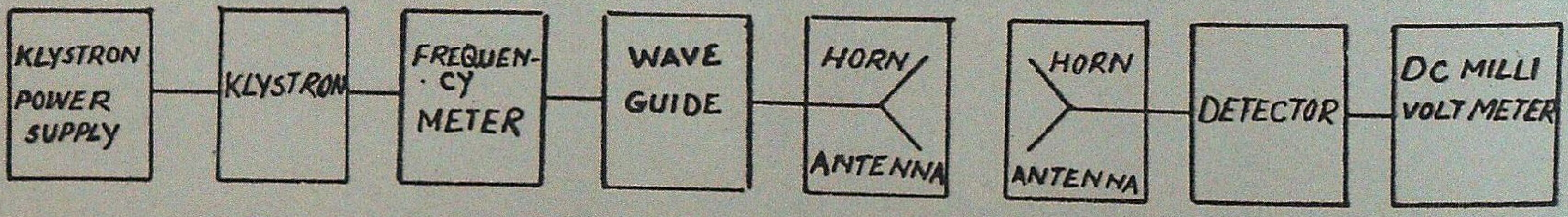
Non-Destructive Testing (NDT) of materials is not only quick and economical in comparison to conventional destructive testing but is also best suited for the study of a sample without altering its basic structure. There are several known NDT techniques for testing of materials but very few methods have been applied for testing of timber and timber products. The initial studies on wood were carried out by vibration techniques and subsequently other methods of testing wood by NDT-techniques came into vogue, Martin *et al.* (1987) showed that microwaves present many advantages for the evaluation of the characteristics of wood in the dry wood processing industries. Advantages are access to more than one variable, efficient coupling in the air, easy automation and reasonable cost. Microwaves are electro-magnetic waves and the speed and attenuation of which depend on the medium in which they are propagated. King (1978) has shown that it is feasible to measure the magnitude of microwaves transmitted through wood. It was therefore, considered useful to study the attenuation of microwaves of few Indian wood-species and the results obtained are presented in this paper.

Materials and Methods

Flat grained, air dried, 2.5 cm thick (in radial direction) planks of six wood species having standard specific gravity range 0.39 to 0.85 (oven dry weight and green volume) were selected. Average standard specific gravity was determined for five end matched specimens from each species as per IS: 1708 (Anon., 1969). The planks were planed with a planer and dressed to 12.5 cm wide strips. Each strip was cross cut to obtain five rectangular specimens of size 12.5 cm x 12.5 cm x 2.5 cm from each wood species.

The experimental arrangement used to determine the attenuation constant is shown in Fig. 1. It essentially consisted of a Klystrom microwave generator, two pyramidal antennas (one acting as a

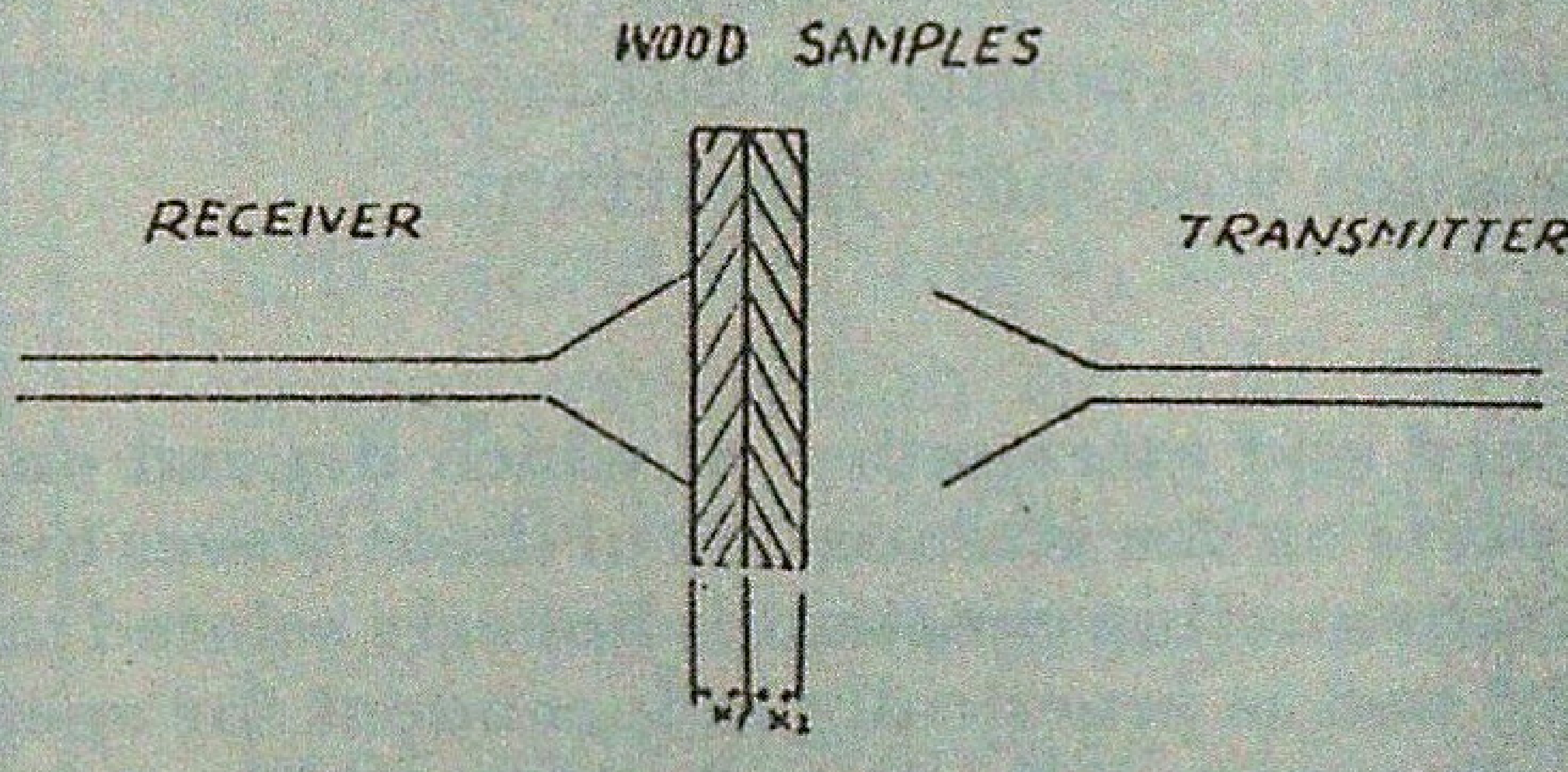
Fig. 1



Experimental arrangement to measure absorption of microwaves by Timber transmitter of microwaves and the other as receiver) and a detector probe. The distance between the two horn antennas was kept greater than $2D^2/\lambda$, where D is the dimension of the horn aperture and λ is the operating wave length. The probe which extended into the wave guide was connected directly to a crystal diode and a DC-milli-voltmeter was used to measure the voltage developed at the diode. The proble output was thus the rectified envelope of the microwave pulses. At the low voltages involved here, the crystal current and hence the voltage was approximately proportional to the square of the applied voltage, so the amplitude of the rectified pulses from the probe was proportional to the square of the electric field sampled by the probe.

Two blocks of timber of thicknesses X_1 and X_2 were kept side by side in between the two horns, with the block of thickness X_2 facing the transmitting horn as shown in Fig. 2.

Fig. 2



Arrangement for mounting Timber specimens

The microwaves were indident normally on the surface. The intensity of microwave (F_1) was measured. The block facing the transmitter was then removed and again the intensity (F_2) was measured.

The attenuation constant (α) was determined by using the relation.

$$\alpha = \frac{2.303}{X_2} (\log_{10}F_2 - \log_{10}F_1) \qquad .....(i)$$

The frequency was measured by a cavity type frequency meter. The measurements were carried out at 8.2 GHZ in the X-band region of microwaves on E_{10} mode of vibration. The thickness of the sample was measured with a vernier calliper. The weight of the sample at test and after oven drying at 102 ± 2^0C for 48 hours was measured. From the two weights, the moisture content at test in percentage was worked out. The measurements were repeated for five samples from each species of wood and average values were worked out.

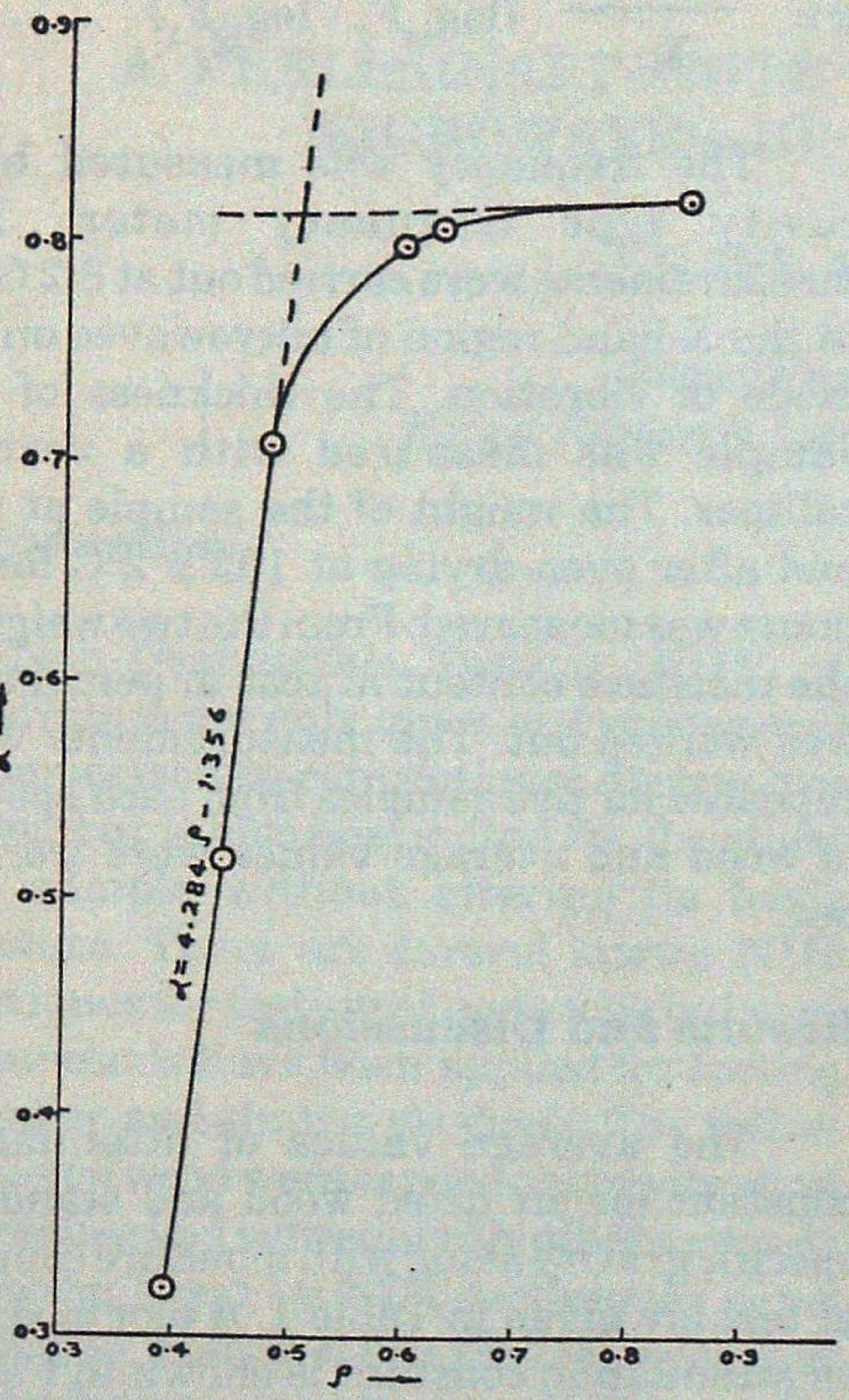
Results and Discussions

The average values of attenuation constant for air dried wood and standard specific gravity along with moisture content at test are given in Table 1. A plot of sp.gr. vs attenuation constant is shown in Fig. 3. The results presented in Fig. 3 show that the attenuation constant (α) increases linearly with a positive slope in the lower density (ρ) range as per the relation;

$$X = 4.284\,\rho - 1.356 \qquad ....(ii)$$

At higher density range, the attenuation constant approaches a constant value. The two portions of the curve on interpolation met at a density of 0.51, suggesting that the attenuation of microwaves is dependent on density below 0.51 and becomes practically independent of density greater than 0.51. This trend of

Fig. 3



Variation of attenuation constant wit Sp.Gr. (ρ)

Table 1

Variation of attenuation constant of woods with Sp. gr.

Species	Standard sp. gr.	Moisture Content at test (%)	Attenuation constant
Abies pindrow	0.39	9.6	0.321
Jacaranda acutifolia	0.44	9.5	0.516
Toona ciliata	0.48	9.2	0.708
Alibizia lebbek	0.60	9.4	0.798
Dalbergia sissoo	0.63	8.3	0.804
Acacia catechu	0.85	8.9	0.819

the curve can therefore, be suitably employed to detect non-destructively the defects like decayed pockets or knots etc. inside the wood. However, research work is needed on Indian wood-species to confirm this. Martin *et al.* (1987) have shown that knots and metallic objects were well detected by the measurement of attenuation, phase and degree of polarization of microwaves in dry wood. When the moisture content of wood become too high (above the fibre saturation point), its influence on measured values was more important.

SUMMARY

Microwaves are electromagnetic waves. The speed and attenuation of which depend on the medium in which they are propagated. This paper reports on the attenuation of these waves by few Indian Wood-species. The results have shown that the attenuation constant is linearly related to the specific gravity of wood for specific gravity below 0.5 and is practically independent for specific gravity range above 0.5. This trend offers a non-destructive method for detecting defects like decayed portion or knots etc. inside the wood.

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References

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1. Asha Publication
34/1, Chakrata Road
Dehradun - 248 001

2. Jarnail Singh (Sahil) IFS
Associate Professor
IGNFA (Residential Complex),
PO New Forest,Dehradun-248 006.

RESEARCH NOTE

GERMINATION OF ELM (*ULMUS LAEVIGATA* ROYLE) AS AFFECTED BY DEPTH OF SOWING

Introduction

Elm (*Ulmus laevigata* Royle) is a medium sized small leaved tree of Punjab Himalayas, which grows upto 7000 ft. elevation (Troup, 1921). The wood is suitable for light construction, planking, packing cases, furniture, bobbins and reels etc. This species is planted around the villages and lopped for fodder. This species has a vast potential in developing suitable agroforestry models/systems in lower hills of Western Himalayas as it is very agro-friendly due to its height and the thin crown spread. It does not interfere with Rabi crops as the tree is devoid of leaves during winter. This species is generally propagate by seeds but its seeds loses viability rapidly even at room temperature (Khosla *et al.*, 1982; Sharma *et al.*, 1991). Information available on its nursery technology is scantly. Hence this study was undertaken to develop its nursery technology by sowing of this species at various depths.

Materials and Methods

The experiment was conducted in Research nursery, Sundernagar of Conifer Research Centre, Shimla. The nursery is situated at an elevation of 800 m and 31°20' to 32°05' N latitude and 75°35' to 77°20' E longitude. The seed collected during March, 1994 from Balh Valley was used in this trial. The seeds of *Ulmus laevigata* were shown in nursery, on 9th April, 1994 in raised beds. The plot consisted of 20 beds, each measuring 1 x 1m. One hundred seeds were sown in each line and there were five lines in each bed at a spacing of 20 cm (line to line). Nursery soil was added to cover the seeds to a depth of 1 cm, 2 cm, 3 cm and 4 cm. Thus there were four treatments, viz T_1-1cm depth, T_2-2cm depth, T_3-3cm depth and T_4-4cm depth, which were replicated five times in Randomized Block design. The mechanical composition of the soil used in this experiment is given in Table 1, which shows that the soil used was silty loam.

Table 1

Mechanical composition of nursery soil

Constituent	Composition (%)
Silt	47.50
Clay	11.00
Coarse	29.75
Fine sand	11.75

The germination of seeds in each treatment was recorded till it was completed. The statistical analysis of the germination percentage was done after arc sin transformation.

Results and Discussions

Germination percentage under different treatments is presented in Table 2.

Table 2

Germination of Ulmus laevigata seed as affected by depth of sowing

Depth of sowing (cm)	R_1	R_2	R_3	R_4	R_5	Germination (per cent)
1	32.00	28.00	33.00	27.00	29.00	29.80
2	18.00	14.00	16.00	17.00	18.00	16.60
3	2.00	2.40	2.00	2.20	1.80	2.08
4	1.20	1.40	1.80	1.00	1.20	1.32
Critical difference						
at 1%						1.57
at 5%						2.21

The results indicate inverse relationship between the germination percentage of seeds and depth of sowing. Germination percentage was decreased as depth of sowing was increased from 1 cm to 4 cm. Germination of 1 cm depth was recorded to be the maximum i.e. 29.80 per cent and it was found statistically significant with other sowing depths viz. 2 cm, 3 cm and 4 cm, at 1% level. Germination percentage with 2 cm depth was also observed 16.60% which is also higher while comparing with 3 cm and 4 cm sowing depths.

Hence, from the above experiment, it is recommended that sowing of *Ulmus laevigata* should be done at 1 cm depth to get the maximum germination percentage.

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H.R. Arya and
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REMEDIES FOR PLANT DISEASES

For powdery mildews use sulphur, dusting it on the plants. For fungi in general use Bordeaux mixture, made as follows : For every 10 gallons take 1 pound of lime and 1 pound of bluestone. Dissolve these separately in hot water and mix when cool, adding the rest of the water. Spray on the plants. Or spray with ammoniacal copper carbonate solution, made as follows : Dissolve 1 ounce of copper carbonate in 6 ounces of ammonia and add 10 gallons of water.

For fungi and scale insects use lime, salt and sulphur mixture, a *winter* wash composed of lime 8 pounds, salt 3 pounds, and sulphur 4 pounds, for each 12 gallons of water. Mix one-fourth of the water, one-fourth of the lime, and all the sulphur and boil for one and-a-half hours; put the salt with the rest of the lime and slake with hot water; add to the above and boil half an hour longer; add the remainder of the water and apply as a spray.

For scale insects use resin soap as follows : For 100 gallons for *summer* use take resin 18 pounds, caustic soda (98%) 3½ pounds, and fish oil 2½ pints; for *winter* use, resin 30 pounds, caustic soda 6¼ pounds, and fish oil 4½ pints. The material is put in a kettle and covered with four or five inches of water. The lid is put on and the mixture boiled two hours or more, and then the rest of the water is added, a little at a time. Spray on the plants. Or use the gas treatment : Cover the plant with an oiled tent, and for each 100 cubic feet of contents place in a bowl beneath the tent 2/3 ounce of water, 1/3 ounce of sulpuric acid (oil of vitriol), and 1/3 ounce of potassium cyanide (58%). Be careful not to inhale the poisonous gas, not to allow it to escape from the tent for half an hour. The leaves may be injured if used during the middle of the day.

For insects in general use kerosene emulsion, as follows : Make a soap solution of half a pound of soap to a gallon of water. Heat it to boiling and add two gallons of kerosene. Pump it through the spray pump, with good pressure, for five or ten minutes. For use add ten times as much water as you have of emulsion. Apply as a spray. Sour milk may be used instead of the soap solution. The emulsion is made more effective by the addition of a very small amount of arsenic to the soap solution, or of buhach to the kerosene.

For fruit of leaf-eating insects use Paris Green or London Purple as a powder at the rate of 1 to 5 pounds to the acre, distributed by walking or riding over the field, carrying a pole, at both ends of which are hung muslin bags containing the poison. As a spray use 1 pound to 200 gallons of water. In spraying these arsenites, the nozzle should be held at some distance from the plant and *no more should be applied after the leaves begin to drip*. Do not use these on crops where the poison would be injurious to health,

- (Indian Museum Notes, IV, 1)

REVIEWS

(I)

Soil salinity and water quality by Ranbir Chhabra. Published by M/s. Oxford and IBH Publishing Co. (P) Ltd., New Delhi. 200 pages; 13 coloured plates and many figures. Price Rs. 475/-

The book presents in detail various principles and practices, translated in adaptable technologies, the adoption of which can lead to preventive measures to control water-logging, soil salinity and package of practices to reclaim wastelands degraded to various level. Emphasis has been given to anthropogenic factors in the development of soil salinity particularly in the developing countries. This book will be useful to students of soil science, agronomy, plant physiology, environmental scientists, planners and those interested. The price is reasonable and size is handy.

- N.S.B.

* * *

(II)

Earthworm, Vermiculture and Vermi composting by R.K. Bhatnagar and P.K. Palta. Published by M/s. Kalyani Publishers, Ludhiana. 106 pages; 7 colour plates and 4 figures. Price Rs. 50/-

This book focuses on the utilization of the earthworm in bio-technology and bio-diversity. The main chapters discussed are origin and evaluation, distribution, food and feeding habits, body structure, their role, organic-waste, Vermi technology, advantages of vermiculutre, harmful or negative roles, vermi-composting, application of vermicompost and explanatory notes to technical terms. The book will be useful to students, scientists, planters and those interested.

- V.K.B.

NEWS AND NOTES

The State Silviculturist, Rajasthan Jaipur has collected 100 qtls. of bamboo seed this year. This seed is available in 5 k. packets. Some seeds have been reserved for distributing to other State Forest Departments, Institutions and Private Individuals as per the demand at the rate of Rs. 100/- per kg excluding charges of packing and forwarding on first come first served basis. Please place your indent directly with State Silviculturist, Rajasthan, Grass Farm Nursery, Khatipura Road, Jaipur.

FORTHCOMING FORESTRY/ENVIRONMENT PROGRAMMES (1996)

1-5 July, 1996
Management of Mountain Watersheds, Lillehammer, Norway.
Contact : E-mail: Sam. Kunkle @ fao. org.

1-26 July, 1996
Making Forest Policy Work (Oxford Summer Course), U.K.
Contact : Kate Harris, Course Coordinator, Oxford Forestry Institute, University of Oxford, South Parks Road, Oxford OXI 3 RB U.K.

13-18 July, 1996
5th ISSR Symposium, Athens, U.S.A.
Contact : J. Box, USDA Agricultural Research Service, Conservation Research Center, 1429 Experimentation Station Rd., Wathinsville, GA, USA,

15-16-July
Workshop on Biodiversity Information, London, U.K.
Contact : Dr. Colin Ogbourne, Informationo Services, CAB International, Wallingford, Oxon, OX10 8DE, U.K.

29 July - 1 August, 1996
Planning and implementing Forest Opetrations for Sustainable Development, Marquette, MI, U.S.A.
Contact : Esko Mikkonen, Univ. of Helsinki, Deptt. of forest resources management, Unionikatu 40B, Pin 00170 Helsinki, Finland.

5-8- August, 1996
Diversity and adaptation in forest eco · systems in a Changing World, Vancouver, BC, Canada.
Contact : Francis C. Yeh Dept. of Renewable Resources, University of Alberta, Canada, T6G2H1.

6-10 August, 1996
Physiological aspects of Xylogenesis in Conifers, Krasnoyarks, Russia.
Contact : V.N. Sukachv, Institute of Forests, Krasnoyarsk, 660036 Russia,

13-17 August, 1996
Quality wood drying through process modelling and novel technologies. Quebec City, Canada.
Contact : Dr. Alain Cloutier, Forintek Canada, Corp: 19 rue Franquet, Sainte-Foy (Quebec),Canada GI P4R4.

18-23 August
Population Synamics, Impacts, and integrated management of forest defoliating insects, Banska, Stiavnica, Slovak Republic.
Contact : Dr. Mike McManus, Northeastern Center for Forest Health Research, 51 Mill Pond Rd, Hamden, CT 06514, USA.

24-August- 1 Sept,1996
Connection between Silviculture and Wood quality through modelling approaches and simulat. Softwares. Kruger National Park, South Africa.
Contact : Gerard Nepveu, INRA, Equipe de Recherches sur la qualite des Bois, Centre de Recherches - INRA de Nancy, 54280 Champenoux, France.

13-22 October, 1997
XI World Forestry Congress, Antalya (Turkey).
Contact : The Secretary General, XI World Forestry Congress, Dept. of Foreign Relations - Ministry of Forestry, Ataturk Bulvari - 153, Ankara (Turkey).

GAZETTE NOTIFICATIONS

ANDHRA PRADESH

1. Shri K.Prakasa Rao, D.F.O., Wildlife Management, Rajahmundry is transferred and posted as D.F.O., Social Forestry, Kakinada vice Shri B.S. Yousuf Sharief, D.F.O. transferred.
2. Shri P.A.V. Udayabhaskar, IFS (85), who is under orders of posting as Deputy Conservator of Forests, State Trading Circle, Hyderabad is transferred and his services are placed at the disposal of Social Welfare Department for appointment as Project Officer, Integrated Tribal Development Agencey, Parvathipuram.
3. Shri Sunil Kumar Gupta, IFS (87), Dy. Conservator of Forests, R&T Circle, Hyderabad is transferred and his services are placed at the disposal of Social Welfare Department for appointment as Project Officer, Integrated Tribal Development Agency, Eturunagaram, Warangal District vice Dr. K. Tirupathaiah, IFS transferred.
4. On transfer Dr. K. Tirupathaiah, IFS (86) is posted as Project Officer, Integrated Tribal Development Agency, Utnoor, Adilabad District.

This cancels the posting of Shri P.A.V. Udayabhaskar, IFS (85) as Deputy Conservator of Forests, State Trading Circle, Hyderabad.

KARNATAKA GAZETTE

Shri H.S.S. Murthy, IFS (KTK 92) Assistant Conservator of Forests waiting for posting is appionted with immediate effect and until further orders as Assistant Conservator of Forests, Gundlupet Sub-Division, Gundlupet, relieving Shri G. Rachaiah, Assistant Conservator of Forests of the additional charge.

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Vol. 110 - 1984. Sept. (spl. Issue), Dec. and Index
Vol. 111 - 1985. Sept., Oct., Nov. (Special Issue), Dec. (Special Issue) and Index
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Vol. 116 - 1990. January to December and Index.
Vol. 117 - 1991. March, April, May (Spl. Issue). Aug., Nov., Dec. and Index.
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Vol. 119 - 1993. January to December.
Vol. 120 - 1994. January to December.
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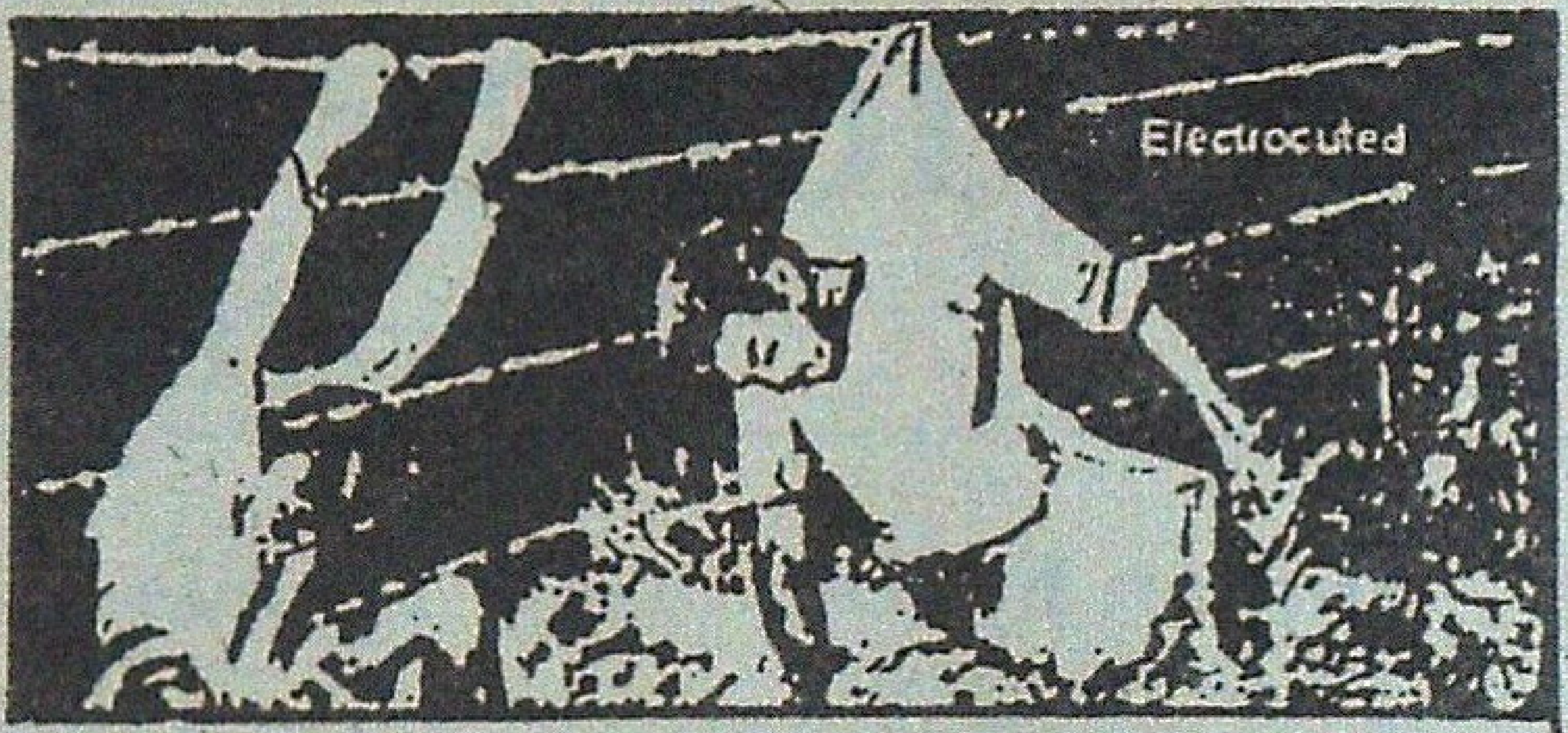

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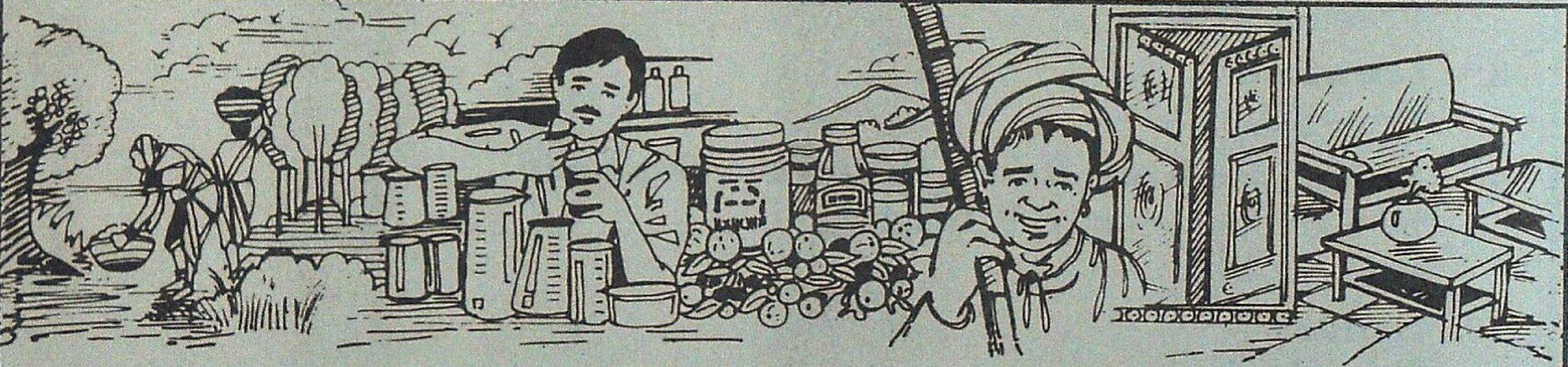

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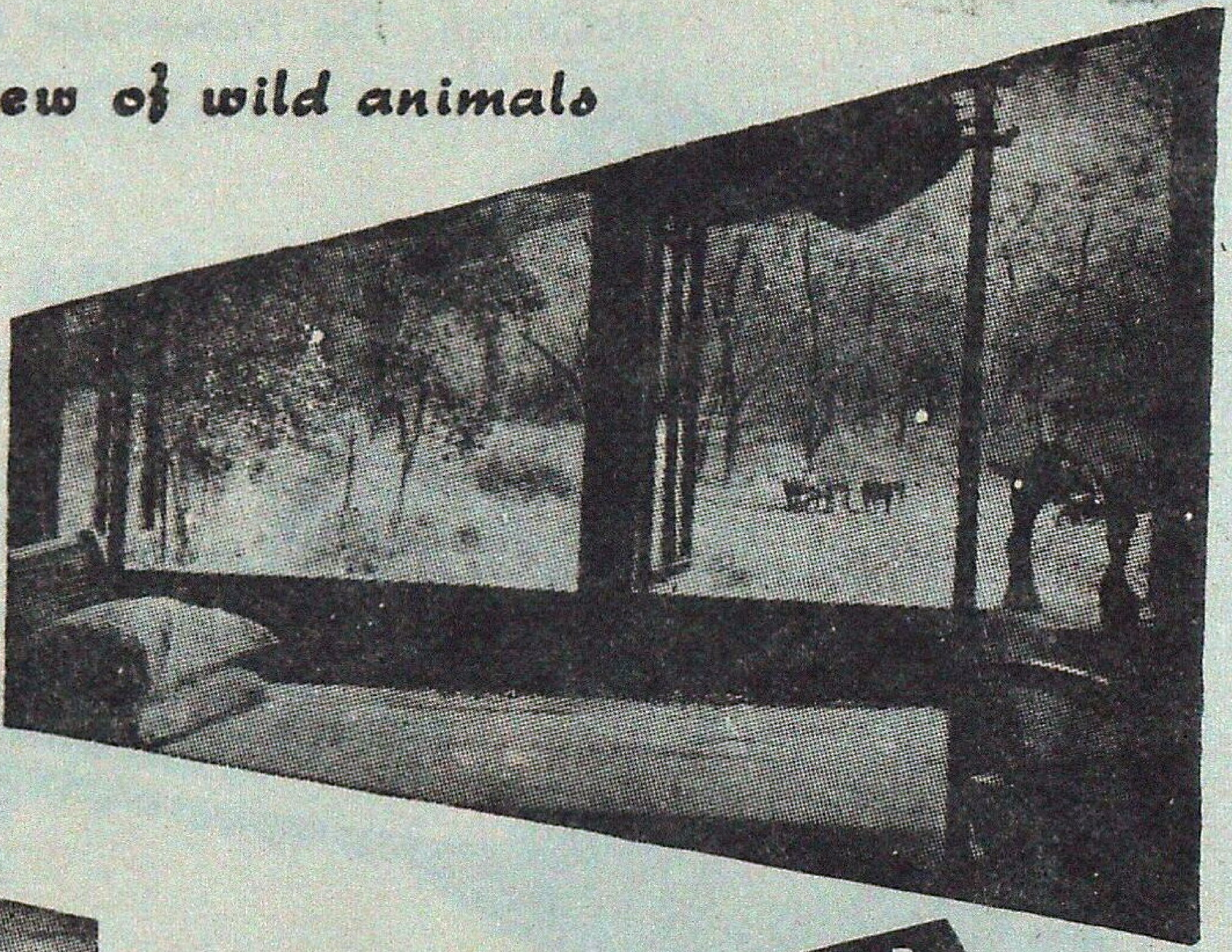

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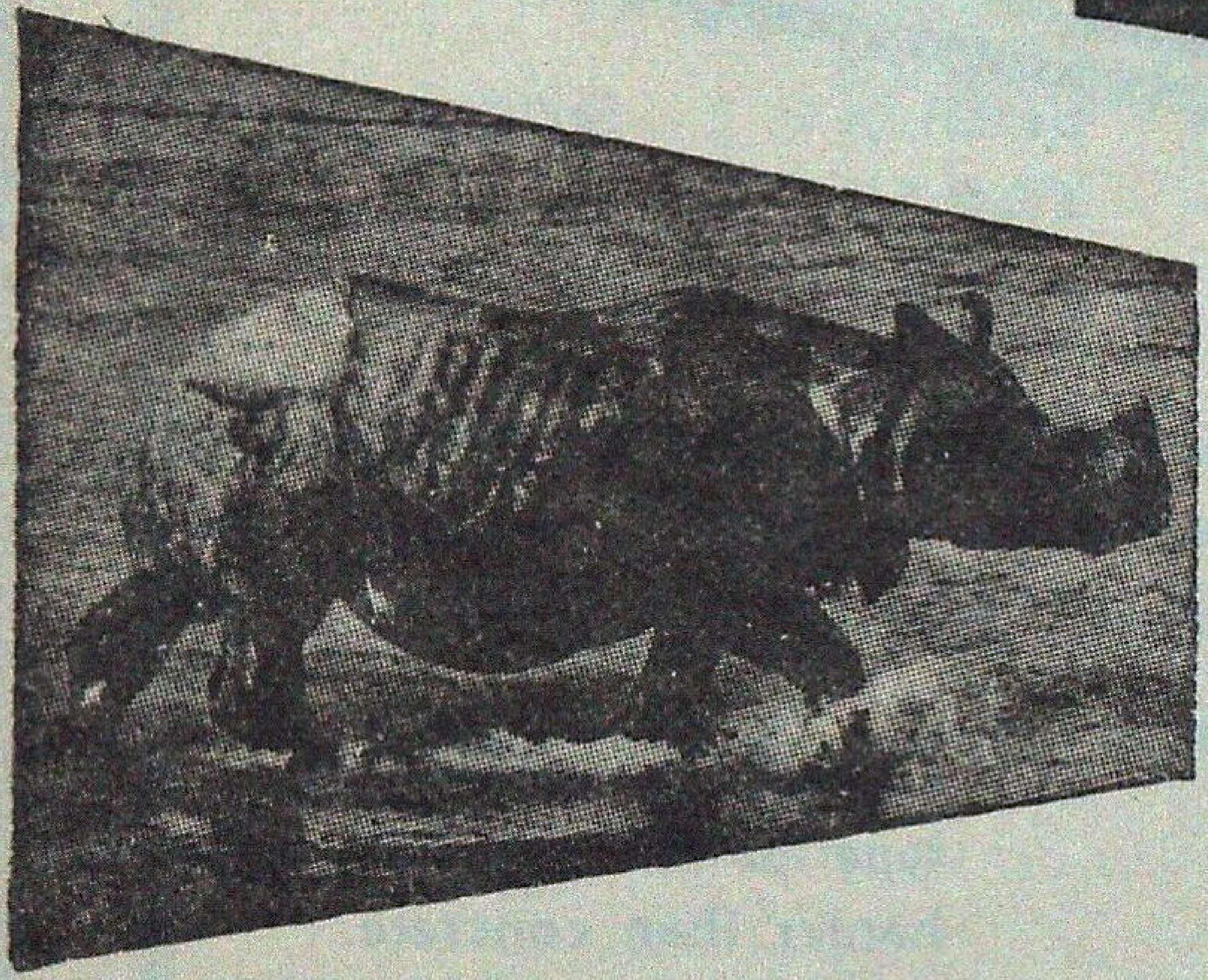

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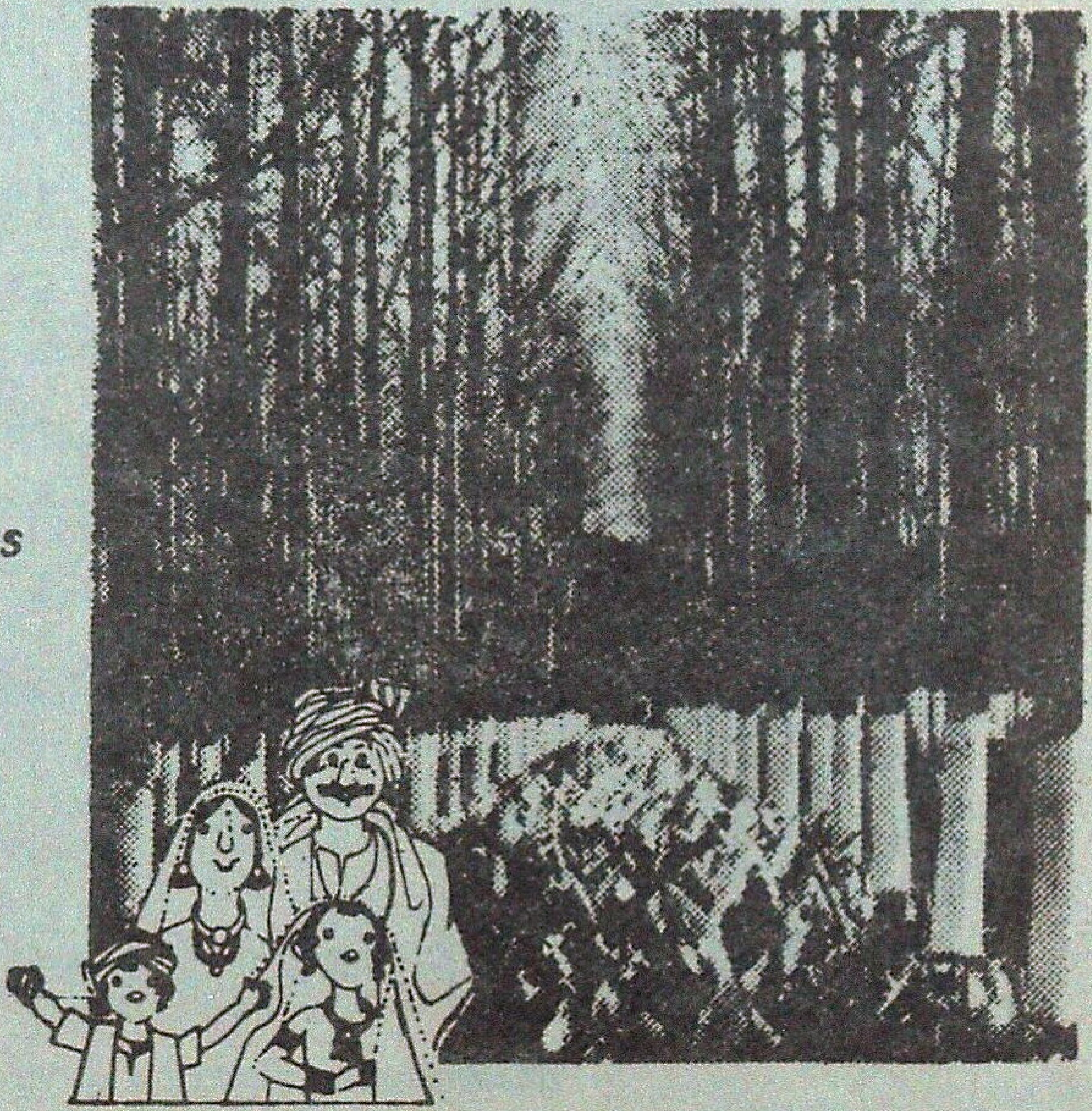

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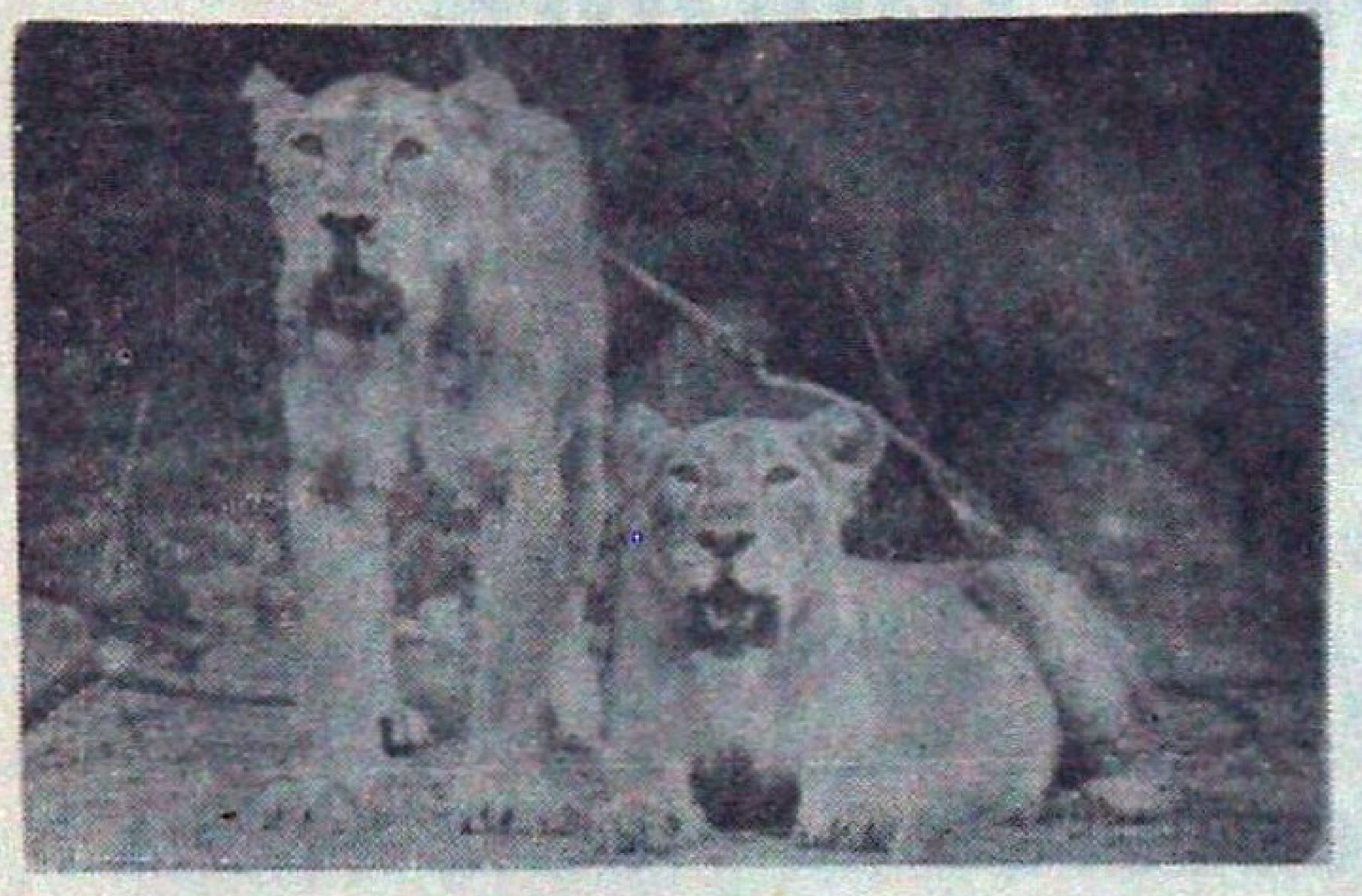

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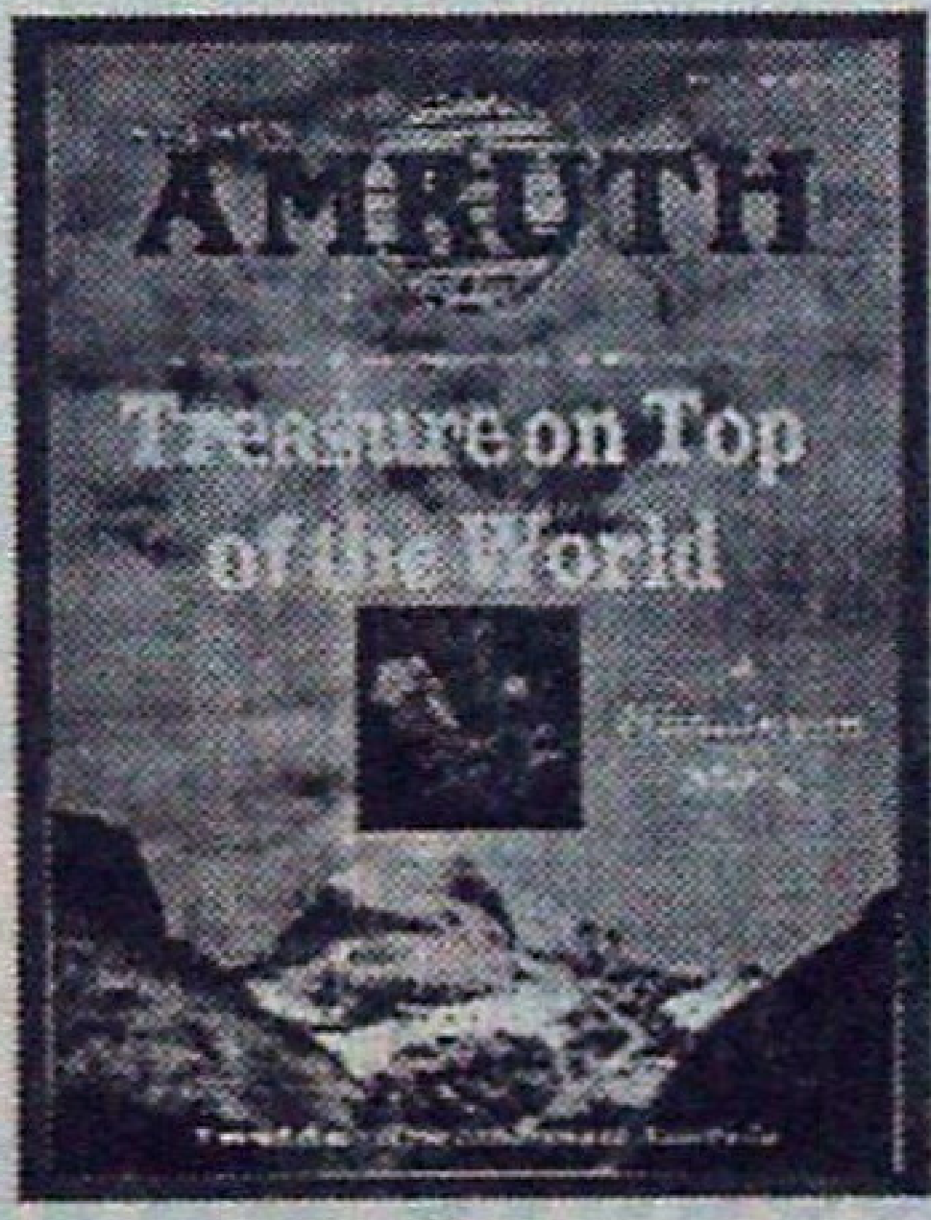
As a support measure, the Foundation has launched a "cultural ambassador" in the form of a magazine to carry its message to as wide a section of the conservation-committed public as possible. AMRUTH, a bi-monthly, gives in-depth analysis of plants, finely-detailed illustrations, feature stories, photo essays and topical medicinal plants-related issues dealing with politics, history and people.

To keep AMRUTH a quality output that can continue disseminating useful information, FRLHT invites subscriptions. We see our subscribers as cultural ambassadors, too; for it is they who will help keep India's medical traditions a dynamic force that can serve future generations.



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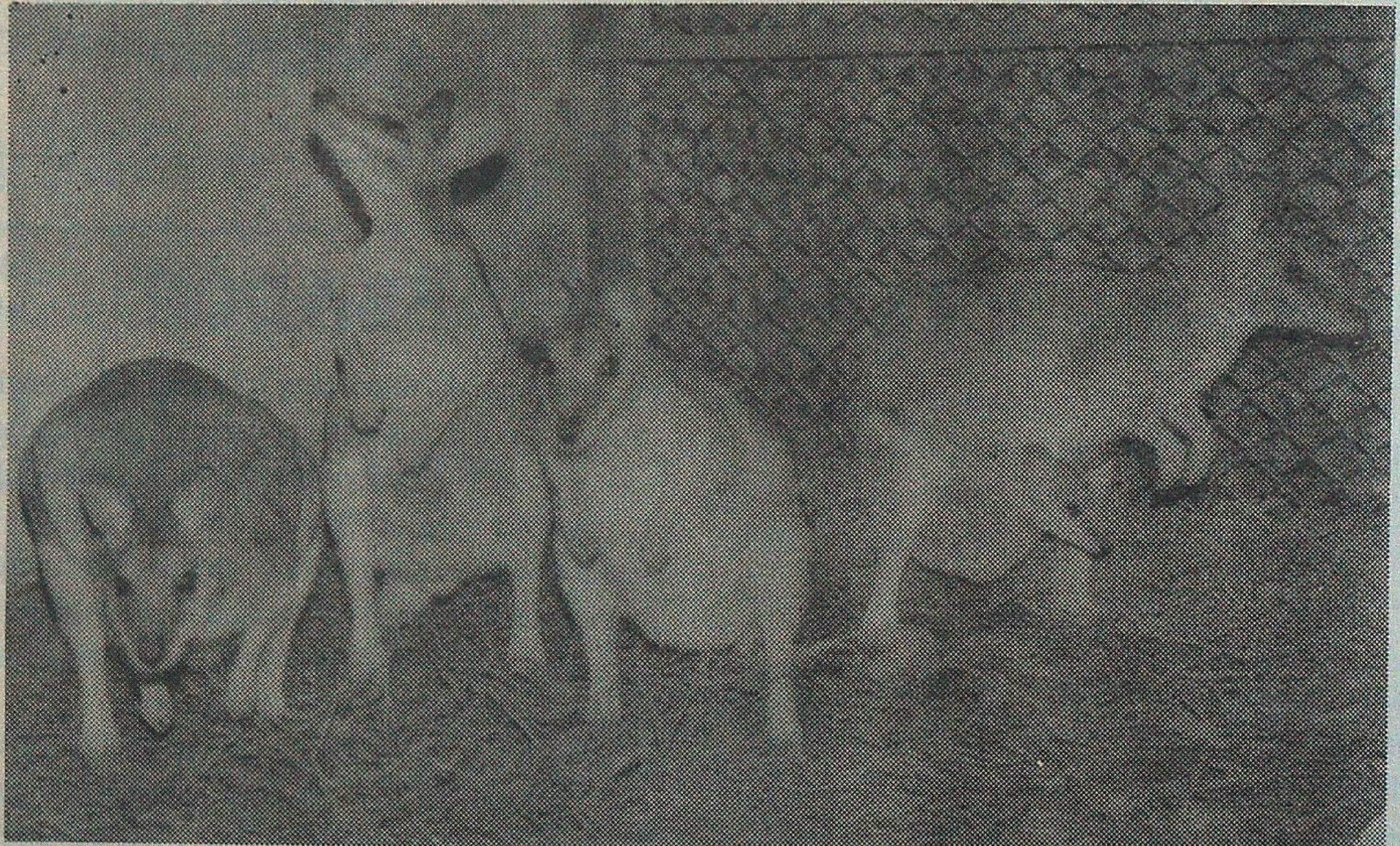

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Dy Conservator of Forests
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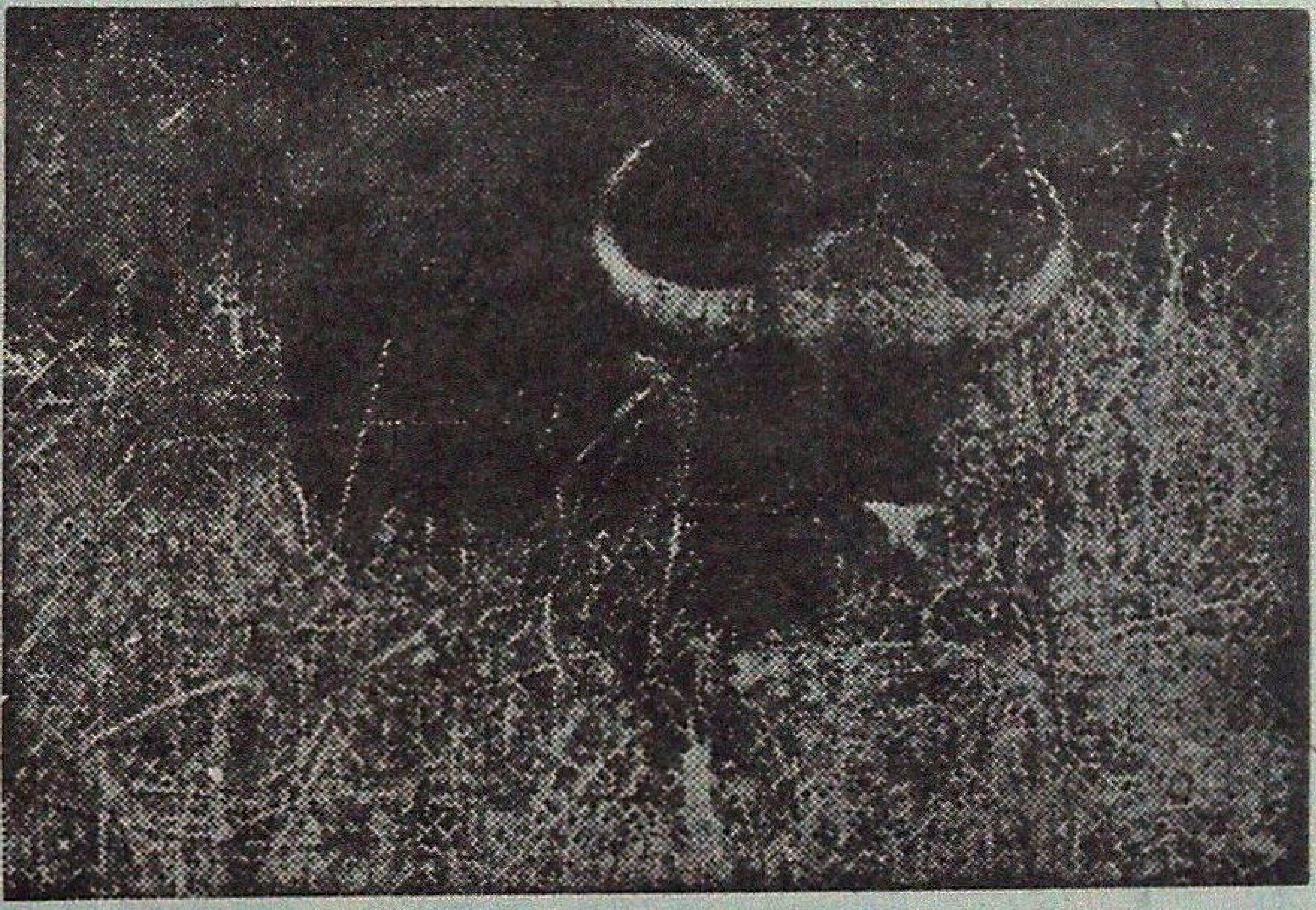

For further particulars write to :

THE FIELD DIRECTOR,
PROJECT TIGER
Palamau Tiger Reserve.
P.O. Daltonganj, Bihar (India)

3 reasons STM is in the business it's in.

There are any number of reasons to be environment conscious but the three listed here should suffice.

Our forest resources are going up in smoke. Everywhere the cry goes up, Get rid of the woods. We need the wood'. You see, wood is the raw material for many processes and has numerous applications. And the logic being used is that in the interest of progress and commerce, if the forests have to be sacrificed, tough! The point is, it means progress in the short run and a dead planet in the long one.

Of course, we need wood. But maybe...just maybe, we don`t need to sacrifice our forests to get it. The trick is in planting trees, lots of trees.

Paste your photograph here

But in today`s dog-eat-dog, rat-eat-rat world, who`s going to worry about the trees? The answer there is to offer people money to do so. Which is what we at STM have done. Get people to plant trees (or rather adopt them) for which they make money. And so do we, in the bargain!

Ah, did we hear the cynic say `But you`re going to chop down the trees anyway?' Yes, that's true, but since our plantations will provide the wood needed by the nation, there will be no need to level our forests. It`s just like farming.

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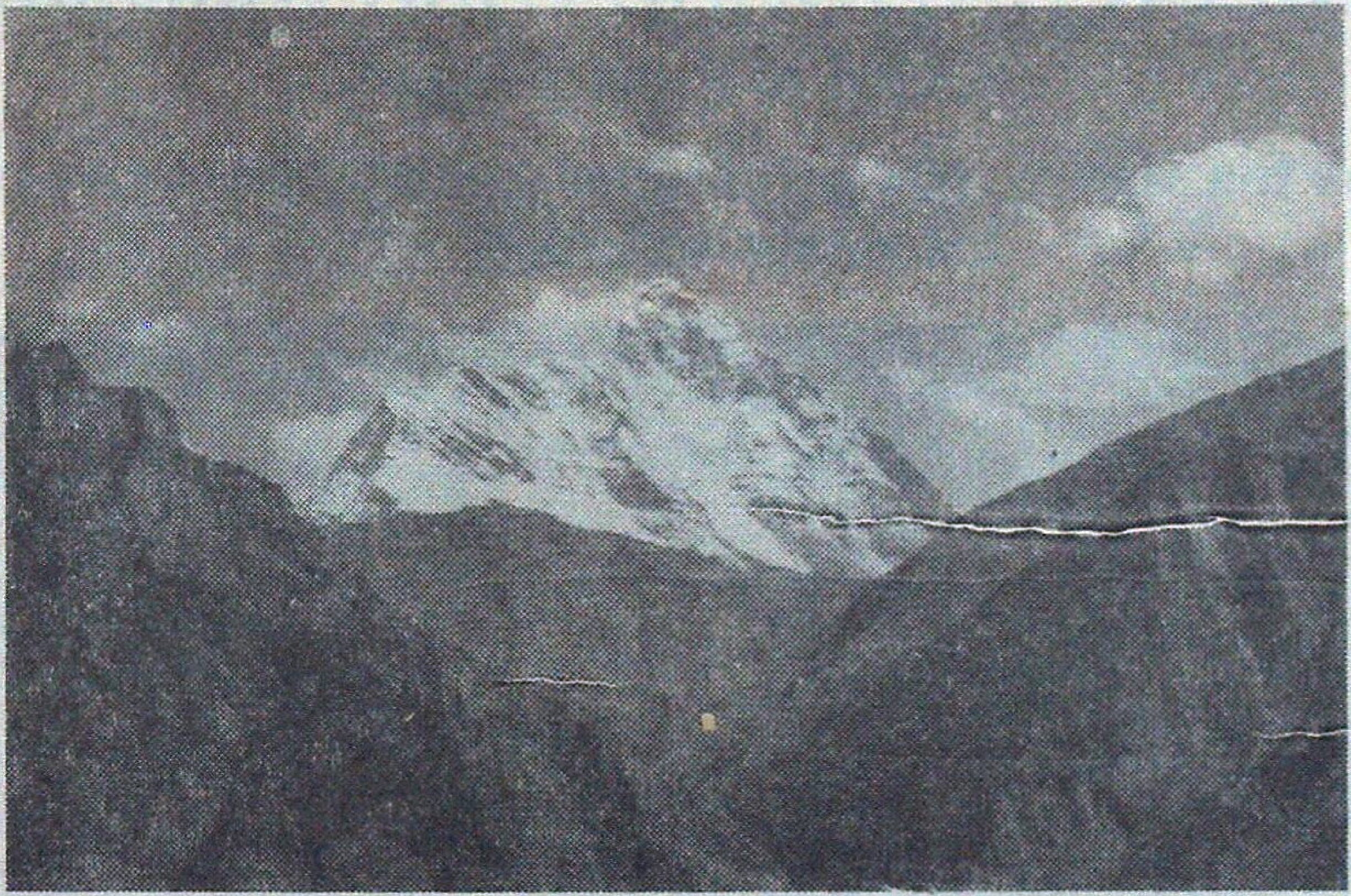
NANDA DEVI BIOSPHERE RESERVE



First Biosphere Reserve in Uttar Pradesh
Established on 18th of January 1988
Total Area 2236 Km^2

Core Zone	: Comprising of Nanda Devi National Park	:	624 km^2
Buffer Zone	: Surrounding the Park (NDNP)	:	1612 km^2
Location	: Himalayan Highlands around Nanda Devi (7817 m) in the civil districts of Chamoli, Pithoragarh and Almora.		

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	Lata-Latakhark-Suraithota	30 km
	Debal-Wan-Roopkund-Ghat	70 km
2. Pithoragarh	: Milam Glacier	
	Munsyari-Milam-Milam Glacier	60 km
3. Almora	: Pindari Glacier	
	Loharkhet-Khati-Pindari Glacier	50 km

BEST VISITING TIME : 15TH JUNE - 15TH OCTOBER

For More Information Contact

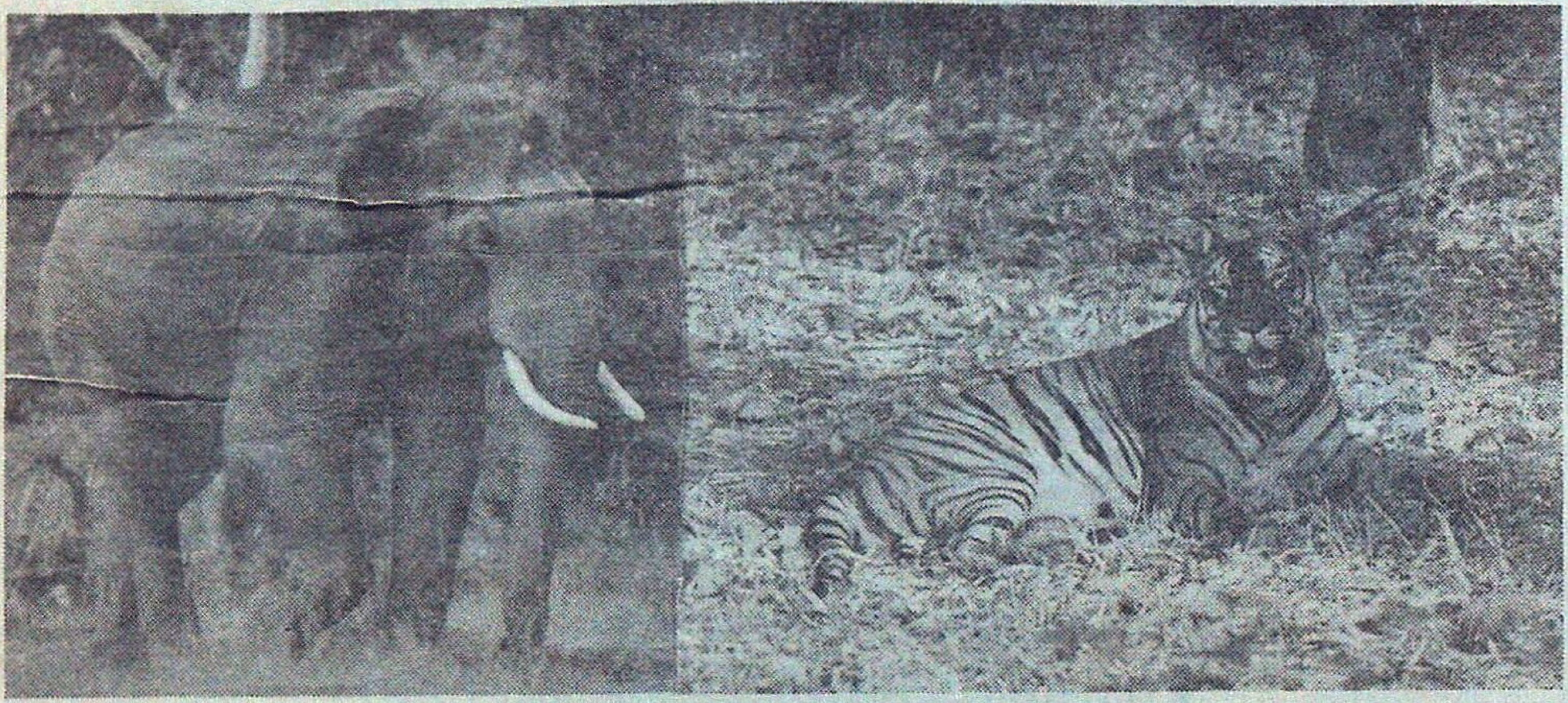
Dy. Conservator of Forests
Nanda Devi National Park,
Joshimath (Chamoli)
Phone No. 2179

Director,
Nanda Devi Biosphere Reserve,
Gopeshwar (Chamoli)
Phone No. 2497

BANDIPUR NATIONAL PARK (Karnataka)

A Unit of Project Tiger

Best Season for visit : May to October but open all the year except in fire season from February to April.



Bandipur nestling itself at the foothills of the Western Ghats in Mysore District is a treasure trove ,of Wildlife, and a paradise for photographers. It encompasses an area of 880 sq. km.

- * It harbours rich heritage of deciduous forests and variety of flora and fauna. Famous for sighting of elephants, gaur, sambar, chital, wild dogs, wild boar, sloth bear, common langur, barking deer and peafowl and if one is lucky, tiger and panther.
- * Beautiful landscape and more than 180 spp. of beautiful birds to watch and enjoy.
- * Approach :- Situated midway at 80 kms from both Mysore and Ooty.
- * Nearest Airports :- Bangalore and Coimbatore.
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Ph : 3341993

Field Director, Project Tiger,
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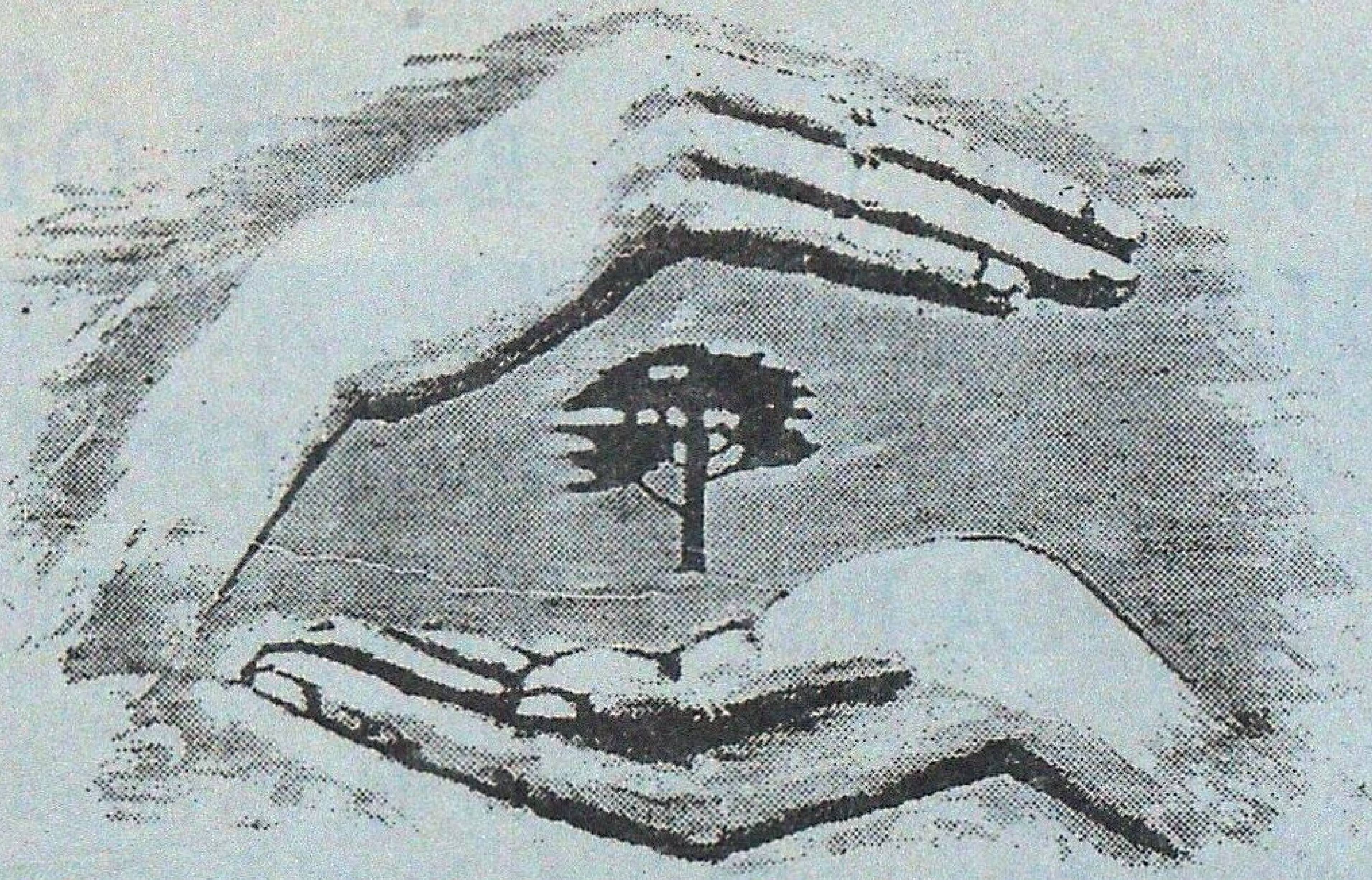

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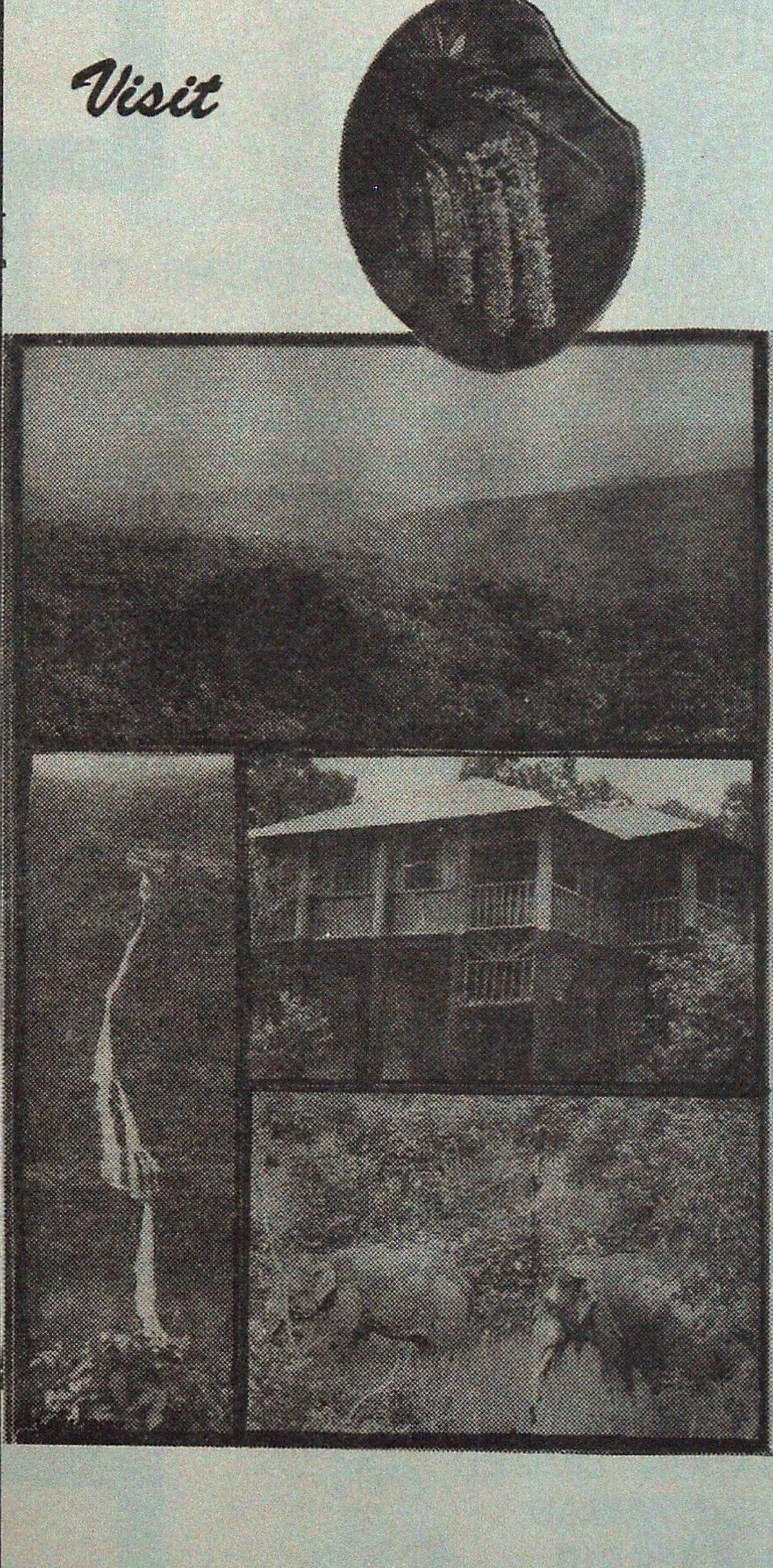

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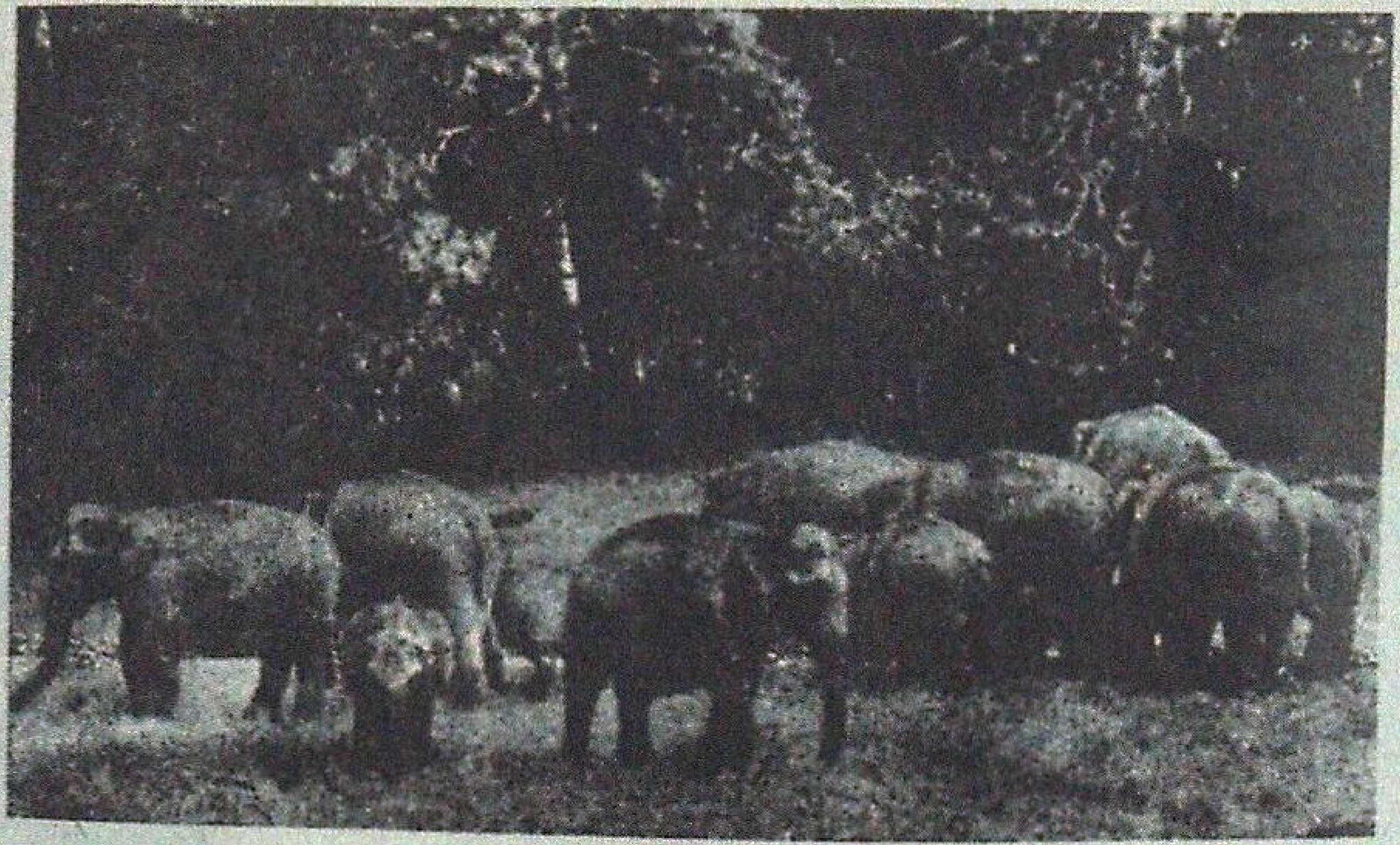

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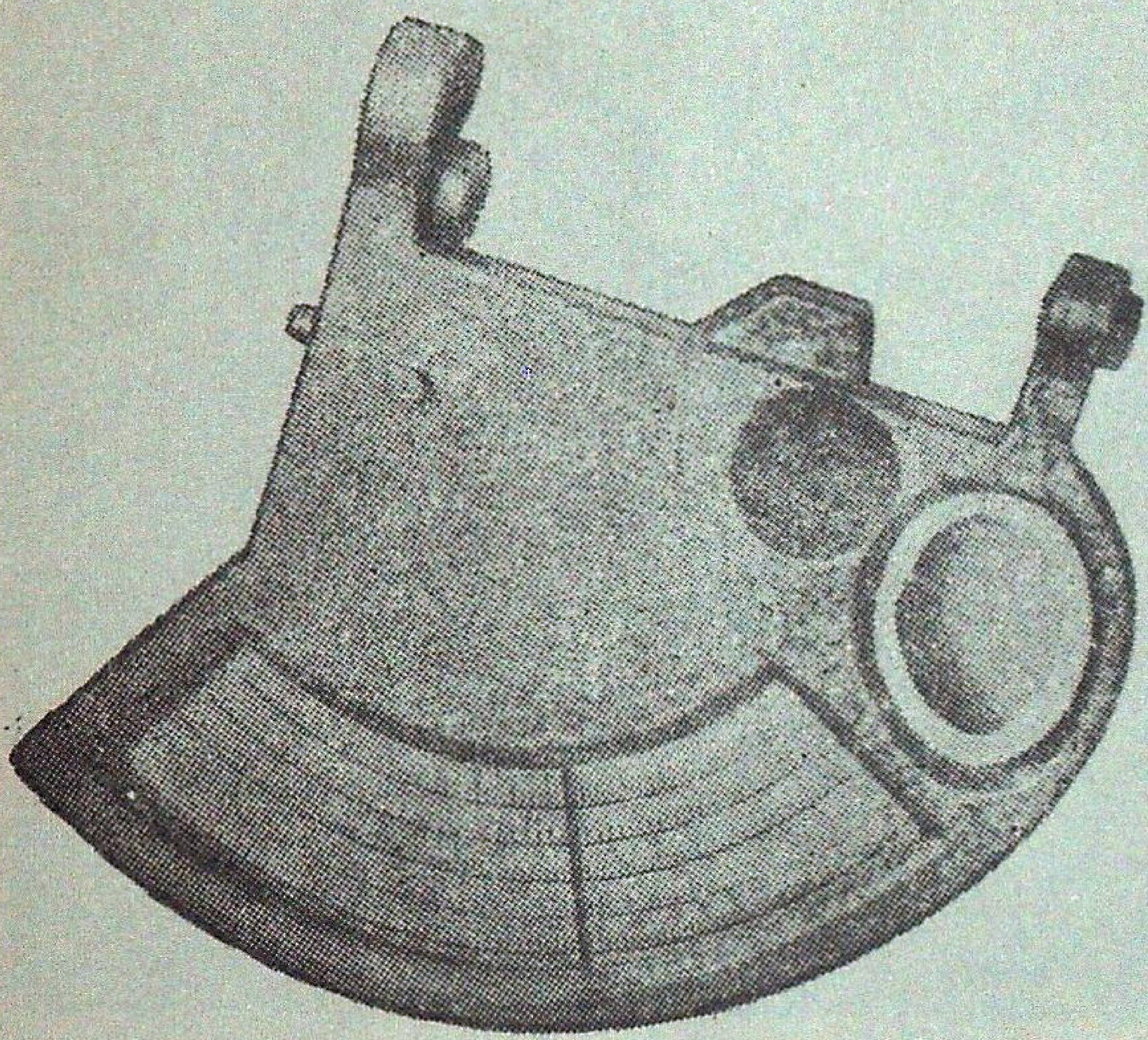

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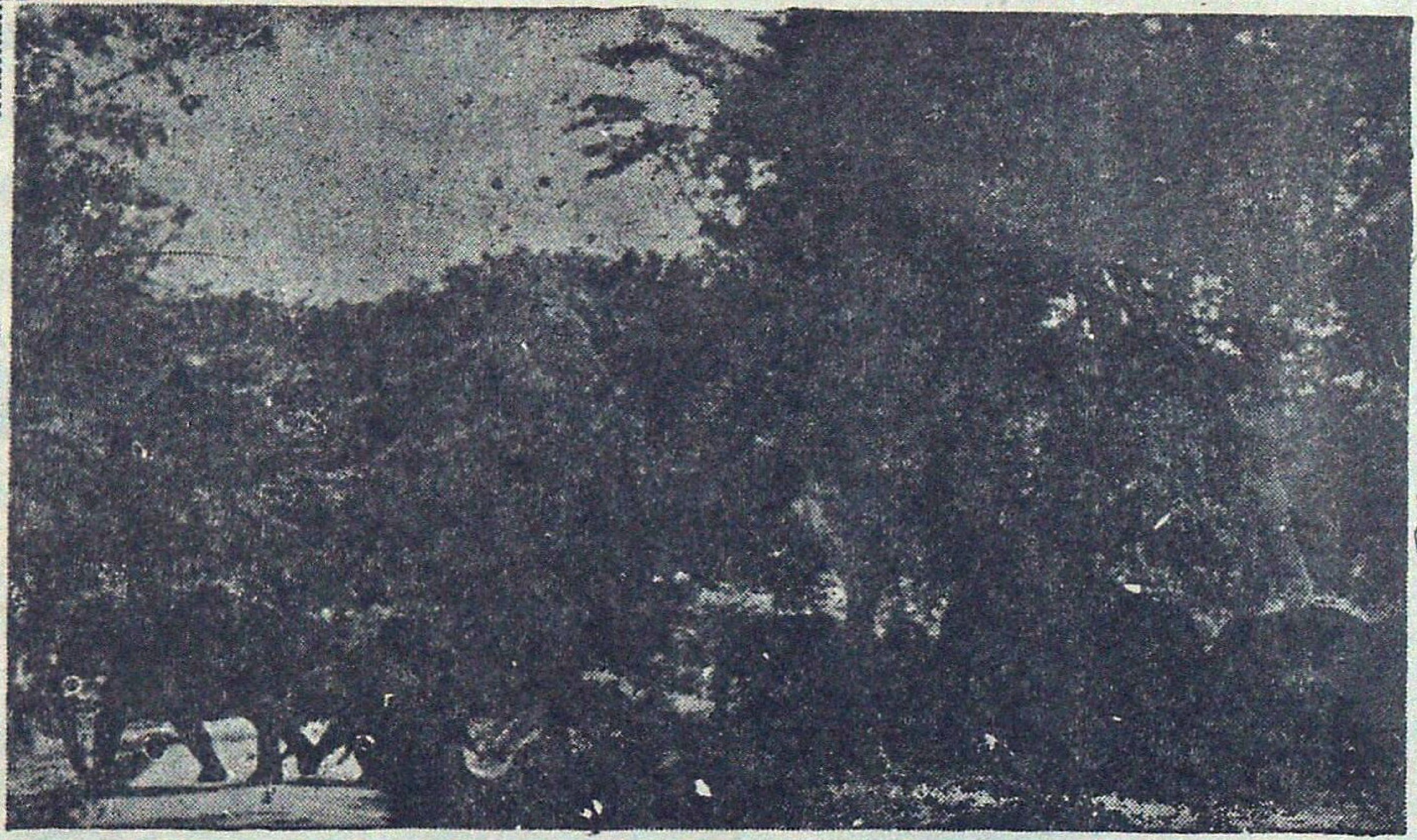

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THE INDIAN FORESTER

VOLUME 122 MAY 1996 NO. 5

The training and research programmes concerning forestry deserve very careful planning and high priority in the overall socio-economic development of the country.

Published by Dr. N.S. Bisht, I.F.S. (Asst. Silviculturist, Gen.) from Forest Research Institute, Dehra Dun on behalf of the Board of Management, Indian Forester, Dehra Dun. Printed by S.K. Arora at Print World, 29-Rajpur Road, Dehra Dun. Hony. Editor : P.B. Gangopadhyay, I.F.S. (Director, Silviculture Research, Forest Research Institute, Dehra Dun).

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